

|                    |            |                                                                                   |                                                                         |
|--------------------|------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------|
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|                    |            | AVC LIQUID CRYSTAL DISPLAY GROUP<br>SHARP CORPORATION<br><b>SPECIFICATION</b>     | LCD MODULE DEVELOPMENT<br>CENTER<br>AVC LIQUID CRYSTAL DISPLAY<br>GROUP |

DEVICE SPECIFICATION FOR

**TFT - LCD module**

MODEL No. LK520D3LZ97

CUSTOMER'S APPROVAL

DATE \_\_\_\_\_

BY \_\_\_\_\_

PRESENTED

BY Makoto Takeda

M. TAKEDA  
 General manager  
 DEVELOPMENT CENTER  
 AVC LIQUID CRYSTAL DISPLAY GROUP  
 SHARP CORPORATION

## RECORDS OF REVISION

**MODEL No. : LK520D3LZ97**

**SPEC No. : LD-19Z08**

[illegible]

## 1. Application

This specification applies to the color 52.0" TFT-LCD module LK520D3LZ97.

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## 2. Overview

This module is a color active matrix LCD module incorporating amorphous silicon TFT (Thin Film Transistor). It is composed of a color TFT-LCD panel, driver ICs, control circuit, power supply circuit, inverter circuit and back light system etc. Graphics and texts can be displayed on a 1920×RGB×1080 dots panel with one billion colors by using LVDS (Low Voltage Differential Signaling) to interface, +12V of DC supply voltages.

This module also includes the DC/AC inverter to drive the CCFT. (+24V of DC supply voltage)

And in order to improve the response time of LCD, this module applies the Over Shoot driving (O/S driving) technology for the control circuit. In the O/S driving technology, signals are being applied to the Liquid Crystal according to a pre-fixed process as an image signal of the present frame when a difference is found between image signal of the previous frame and that of the current frame after comparing them.

With this technology, image signals can be set so that liquid crystal response completes within one frame. As a result, motion blur reduces and clearer display performance can be realized.

This LCD module also adopts Double Frame Rate driving method.

With combination of these technologies, motion blur can be reduced and clearer display performance can be realized.

## 3. Mechanical Specifications

| Parameter                    | Specifications                                | Unit  |
|------------------------------|-----------------------------------------------|-------|
| Display size                 | 132.174 (Diagonal)                            | cm    |
|                              | 52.0 (Diagonal)                               | inch  |
| Active area                  | 1152.0(H) x 648.0 (V)                         | mm    |
| Pixel Format                 | 1920(H) x 1080(V)<br>(1pixel = R + G + B dot) | pixel |
| Pixel pitch                  | 0.600(H) x 0.600 (V)                          | mm    |
| Pixel configuration          | R, G, B vertical stripe                       |       |
| Display mode                 | Normally black                                |       |
| Unit Outline Dimensions (*1) | 1219.0(W) x 706.7(H) x 64.6(D)                | mm    |
| Mass                         | 21.0 ±1.0                                     | kg    |
| Surface treatment            | Anti glare<br>Hard coating: 2H                |       |

(\*1) Outline dimensions are shown in Fig.1 (excluding protruding portion)

## 4. Input Terminals

### 4.1. TFT panel driving

CN1 (Interface signals and +12V DC power supply) (Shown in Fig.1)

Using connector : FI-RE51S-HF (Japan Aviation Electronics Ind., Ltd.)

Mating connector : FI-RE51HL, FI-RE51CL (Japan Aviation Electronics Ind., Ltd.)

Mating LVDS transmitter : THC63LVD1023 or equivalent device

| Pin No. | Symbol   | Function                                           | Remark            |
|---------|----------|----------------------------------------------------|-------------------|
| 1       | GND      |                                                    |                   |
| 2       | Reserved | It is required to set non-connection(OPEN)         | Pull up 3.3V      |
| 3       | Reserved | It is required to set non-connection(OPEN)         | Pull up 3.3V      |
| 4       | Reserved | It is required to set non-connection(OPEN)         | Pull up 3.3V      |
| 5       | FRAME    | Frame frequency setting 1:60Hz 0:50Hz [Note1]      | Pull down : (GND) |
| 6       | O/S set  | O/S operation setting H:O/S ON, L:O/S OFF [Note 3] | Pull up 3.3V      |
| 7       | SELLVDS  | Select LVDS data order [Note1,2]                   | Pull down : (GND) |
| 8       | Reserved | It is required to set non-connection(OPEN)         | Pull down : (GND) |
| 9       | Reserved | It is required to set non-connection(OPEN)         | Pull down : (GND) |
| 10      | Reserved | It is required to set non-connection(OPEN)         | Pull down : (GND) |
| 11      | GND      |                                                    |                   |
| 12      | AIN0-    | Aport (-)LVDS CH0 differential data input          |                   |
| 13      | AIN0+    | Aport (+)LVDS CH0 differential data input          |                   |
| 14      | AIN1-    | Aport (-)LVDS CH1 differential data input          |                   |
| 15      | AIN1+    | Aport (+)LVDS CH1 differential data input          |                   |
| 16      | AIN2-    | Aport (-)LVDS CH2 differential data input          |                   |
| 17      | AIN2+    | Aport (+)LVDS CH2 differential data input          |                   |
| 18      | GND      |                                                    |                   |
| 19      | ACK-     | Aport LVDS Clock signal(-)                         |                   |
| 20      | ACK+     | Aport LVDS Clock signal(+)                         |                   |
| 21      | GND      |                                                    |                   |
| 22      | AIN3-    | Aport (-)LVDS CH3 differential data input          |                   |
| 23      | AIN3+    | Aport (+)LVDS CH3 differential data input          |                   |
| 24      | AIN4-    | Aport (-)LVDS CH4 differential data input          |                   |
| 25      | AIN4+    | Aport (+)LVDS CH4 differential data input          |                   |
| 26      | GND      |                                                    |                   |
| 27      | GND      |                                                    |                   |
| 28      | BIN0-    | Bport (-)LVDS CH0 differential data input          |                   |
| 29      | BIN0+    | Bport (+)LVDS CH0 differential data input          |                   |
| 30      | BIN1-    | Bport (-)LVDS CH1 differential data input          |                   |
| 31      | BIN1+    | Bport (+)LVDS CH1 differential data input          |                   |
| 32      | BIN2-    | Bport (-)LVDS CH2 differential data input          |                   |
| 33      | BIN2+    | Bport (+)LVDS CH2 differential data input          |                   |
| 34      | GND      |                                                    |                   |
| 35      | BCK-     | Bport LVDS Clock signal(-)                         |                   |
| 36      | BCK+     | Bport LVDS Clock signal(+)                         |                   |
| 37      | GND      |                                                    |                   |
| 38      | BIN3-    | Bport (-)LVDS CH3 differential data input          |                   |
| 39      | BIN3+    | Bport (+)LVDS CH3 differential data input          |                   |
| 40      | BIN4-    | Bport (-)LVDS CH4 differential data input          |                   |
| 41      | BIN4+    | Bport (+)LVDS CH4 differential data input          |                   |
| 42      | GND      |                                                    |                   |
| 43      | GND      |                                                    |                   |
| 44      | GND      |                                                    |                   |

|    |     |                   |  |
|----|-----|-------------------|--|
| 45 | GND |                   |  |
| 46 | GND |                   |  |
| 47 | VCC | +12V Power Supply |  |
| 48 | VCC | +12V Power Supply |  |
| 49 | VCC | +12V Power Supply |  |
| 50 | VCC | +12V Power Supply |  |
| 51 | VCC | +12V Power Supply |  |

CN2 (Interface signals) (Shown in Fig1)

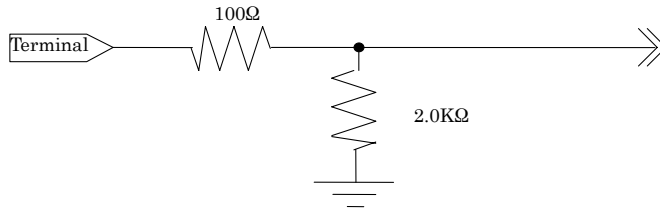
Using connector : FI-RE41S-HF (Japan Aviation Electronics Ind., Ltd.)

Mating connector : FI-RE41HL, FI-RE41CL (Japan Aviation Electronics Ind., Ltd.)

| Pin No. | Symbol         | Function                                  | Remark |
|---------|----------------|-------------------------------------------|--------|
| 1       | Reserved (VCC) | (+12V Power Supply)                       |        |
| 2       | Reserved (VCC) | (+12V Power Supply)                       |        |
| 3       | Reserved (VCC) | (+12V Power Supply)                       |        |
| 4       | Reserved (VCC) | (+12V Power Supply)                       |        |
| 5       | Reserved       |                                           |        |
| 6       | Reserved       |                                           |        |
| 7       | Reserved       |                                           |        |
| 8       | Reserved       |                                           |        |
| 9       | GND            |                                           |        |
| 10      | CIN0-          | Cport (-)LVDS CH0 differential data input |        |
| 11      | CIN0+          | Cport (+)LVDS CH0 differential data input |        |
| 12      | CIN1-          | Cport (-)LVDS CH1 differential data input |        |
| 13      | CIN1+          | Cport (+)LVDS CH1 differential data input |        |
| 14      | CIN2-          | Cport (-)LVDS CH2 differential data input |        |
| 15      | CIN2+          | Cport (+)LVDS CH2 differential data input |        |
| 16      | GND            |                                           |        |
| 17      | CCK-           | Cport LVDS Clock signal(-)                |        |
| 18      | CCK+           | Cport LVDS Clock signal(+)                |        |
| 19      | GND            |                                           |        |
| 20      | CIN3-          | Cport (-)LVDS CH3 differential data input |        |
| 21      | CIN3+          | Cport (+)LVDS CH3 differential data input |        |
| 22      | CIN4-          | Cport (-)LVDS CH4 differential data input |        |
| 23      | CIN4+          | Cport (+)LVDS CH4 differential data input |        |
| 24      | GND            |                                           |        |
| 25      | GND            |                                           |        |
| 26      | DIN0-          | Dport (-)LVDS CH0 differential data input |        |
| 27      | DIN0+          | Dport (+)LVDS CH0 differential data input |        |
| 28      | DIN1-          | Dport (-)LVDS CH1 differential data input |        |
| 29      | DIN1+          | Dport (+)LVDS CH1 differential data input |        |
| 30      | DIN2-          | Dport (-)LVDS CH2 differential data input |        |
| 31      | DIN2+          | Dport (+)LVDS CH2 differential data input |        |
| 32      | GND            |                                           |        |
| 33      | DCK-           | Dport LVDS Clock signal(-)                |        |
| 34      | DCK+           | Dport LVDS Clock signal(+)                |        |
| 35      | GND            |                                           |        |
| 36      | DIN3-          | Dport (-)LVDS CH3 differential data input |        |
| 37      | DIN3+          | Dport (+)LVDS CH3 differential data input |        |
| 38      | DIN4-          | Dport (-)LVDS CH4 differential data input |        |
| 39      | DIN4+          | Dport (+)LVDS CH4 differential data input |        |
| 40      | GND            |                                           |        |
| 41      | GND            |                                           |        |

[Note] GND of a liquid crystal panel drive part has connected with a module chassis.

[Note 1] The equivalent circuit figure of the terminal

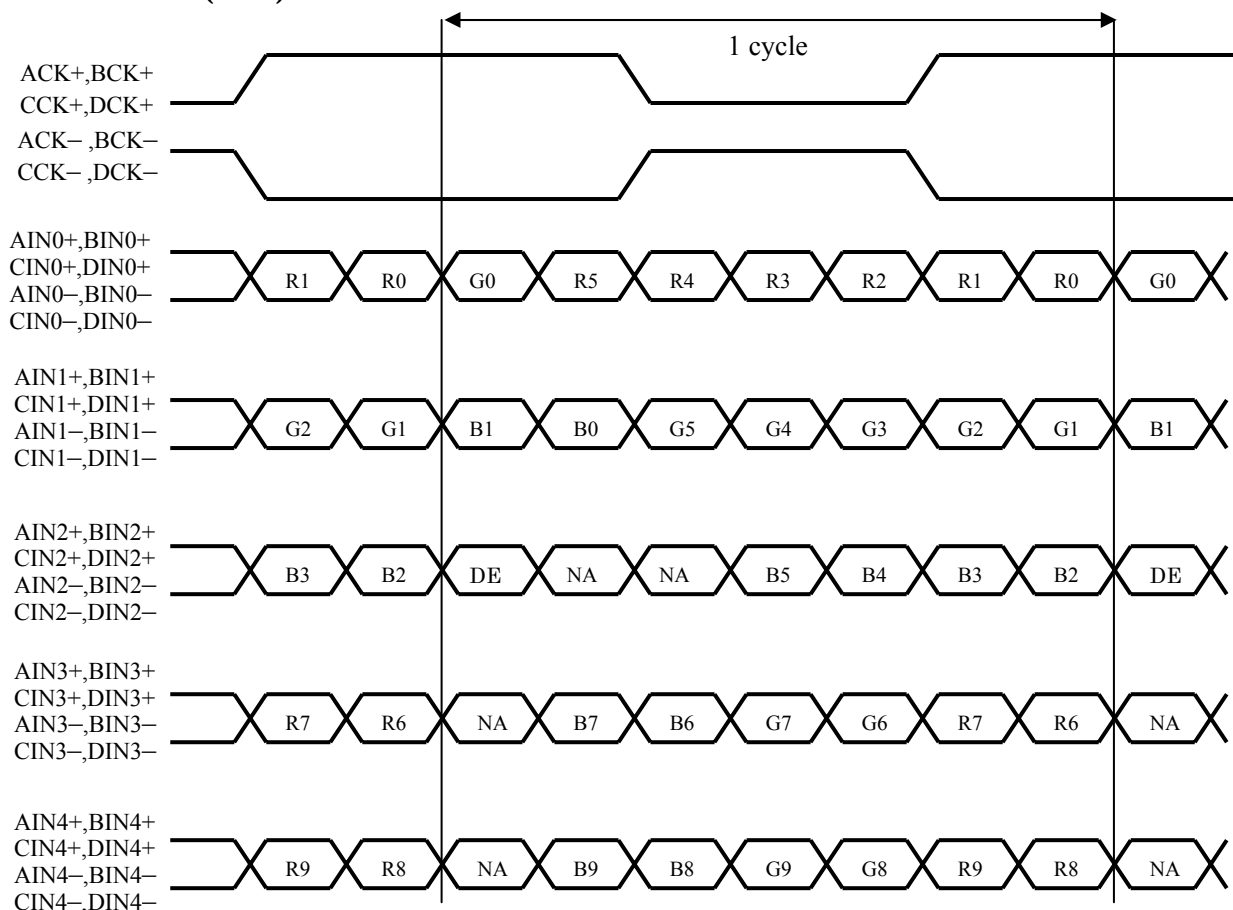
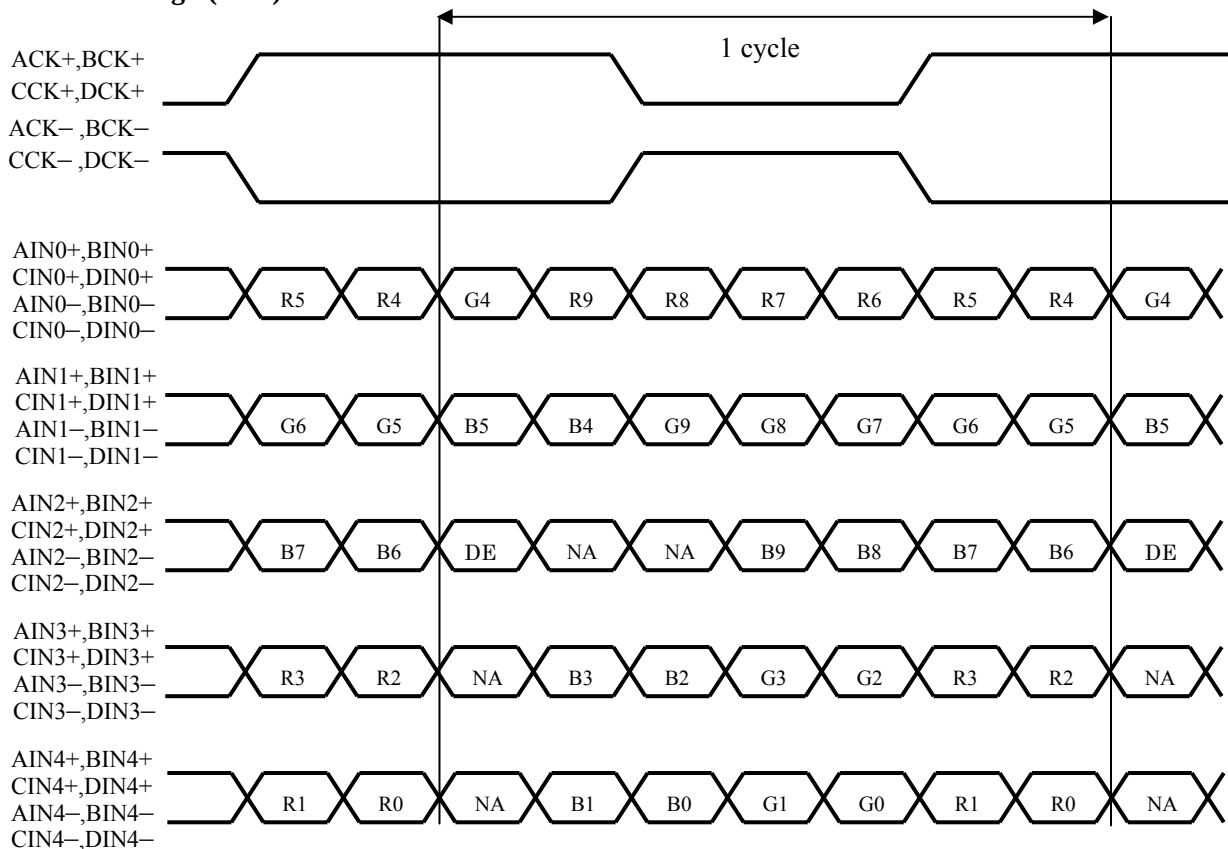


[Note 2] LVDS Data order

| SELLVDS |                          |                    |
|---------|--------------------------|--------------------|
| Data    | L(GND) or Open<br>[VESA] | H(3.3V)<br>[JEIDA] |
| TA0     | R0(LSB)                  | R4                 |
| TA1     | R1                       | R5                 |
| TA2     | R2                       | R6                 |
| TA3     | R3                       | R7                 |
| TA4     | R4                       | R8                 |
| TA5     | R5                       | R9(MSB)            |
| TA6     | G0(LSB)                  | G4                 |
| TB0     | G1                       | G5                 |
| TB1     | G2                       | G6                 |
| TB2     | G3                       | G7                 |
| TB3     | G4                       | G8                 |
| TB4     | G5                       | G9(MSB)            |
| TB5     | B0(LSB)                  | B4                 |
| TB6     | B1                       | B5                 |
| TC0     | B2                       | B6                 |
| TC1     | B3                       | B7                 |
| TC2     | B4                       | B8                 |
| TC3     | B5                       | B9(MSB)            |
| TC4     | NA                       | NA                 |
| TC5     | NA                       | NA                 |
| TC6     | DE(*)                    | DE(*)              |
| TD0     | R6                       | R2                 |
| TD1     | R7                       | R3                 |
| TD2     | G6                       | G2                 |
| TD3     | G7                       | G3                 |
| TD4     | B6                       | B2                 |
| TD5     | B7                       | B3                 |
| TD6     | N/A                      | N/A                |
| TE0     | R8                       | R0(LSB)            |
| TE1     | R9(MSB)                  | R1                 |
| TE2     | G8                       | G0(LSB)            |
| TE3     | G9(MSB)                  | G1                 |
| TE4     | B8                       | B0(LSB)            |
| TE5     | B9(MSB)                  | B1                 |
| TE6     | N/A                      | N/A                |

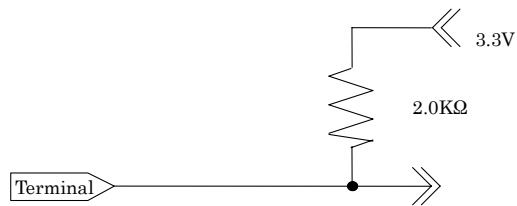
NA: Not Available

(\*) Since the display position is prescribed by the rise of DE(Display Enable) signal, please do not fix DE signal during operation at "High".

**SELLVDS= Low (GND) or OPEN****SELLVDS= High (3.3V)**

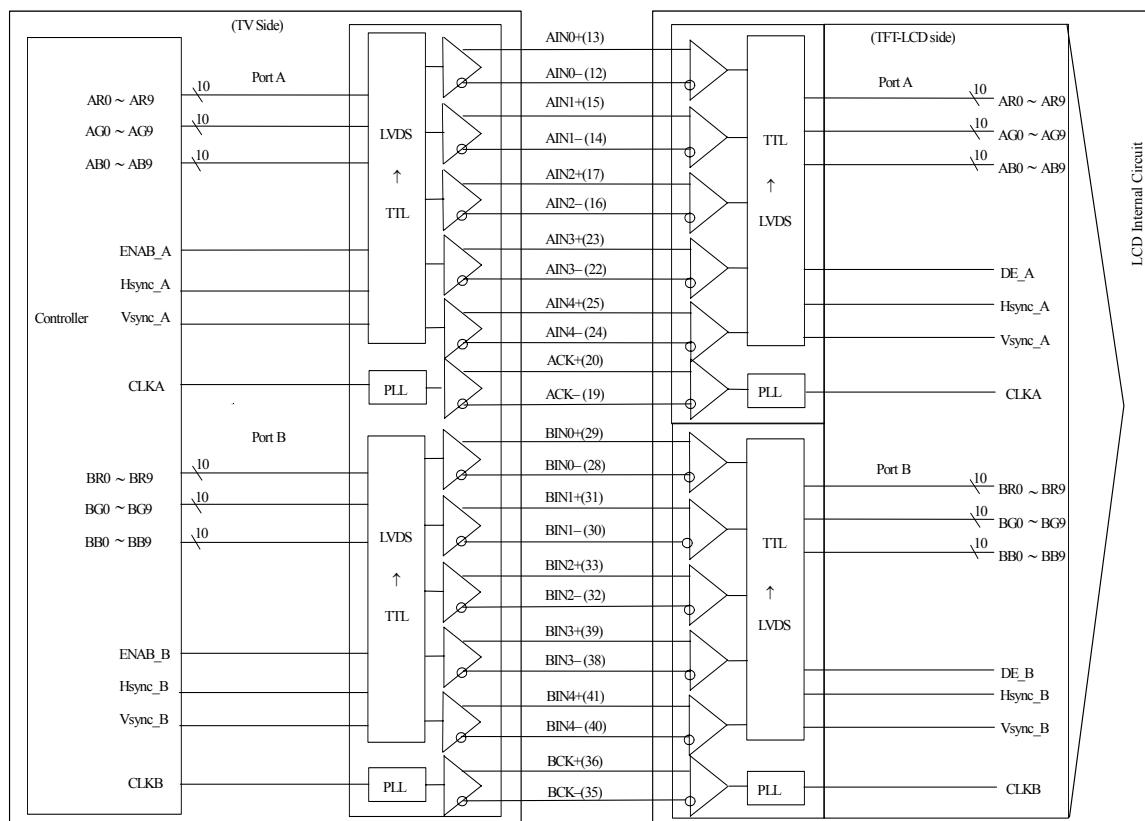
DE: Display Enable, NA: Not Available (Fixed Low)

[Note 3] The equivalent circuit figure of the terminal



## 4.2. Interface block diagram

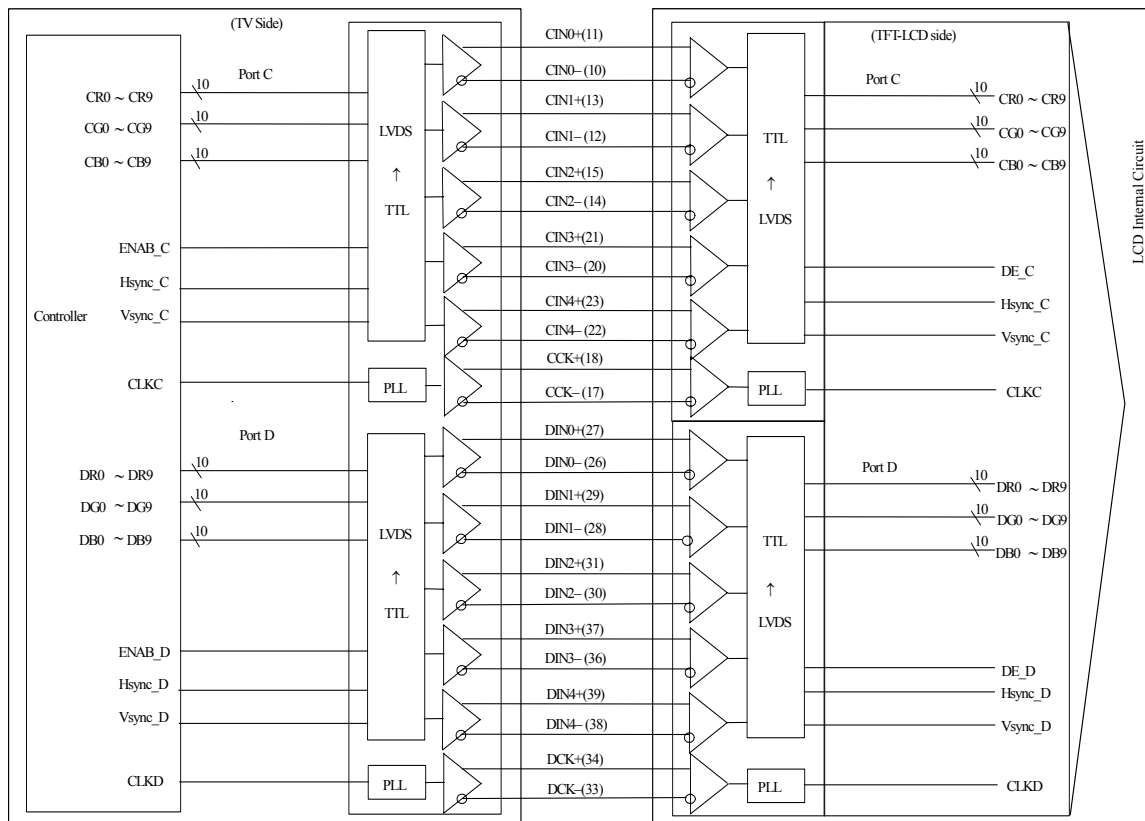
CN1 side:



Corresponding Transmitter: THC63LVD1023 (THine) or equivalent device.

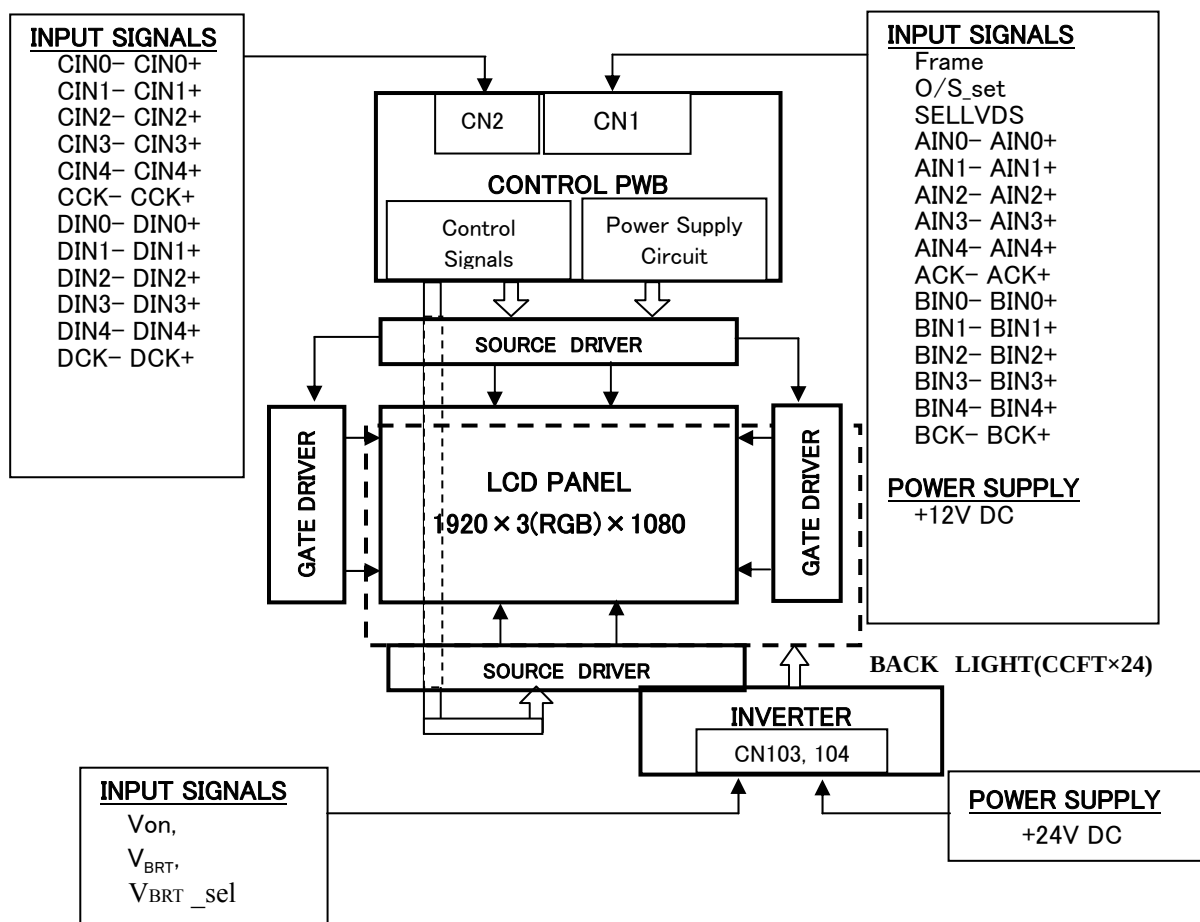


CN2 side:



Corresponding Transmitter: THC63LVD1023 (THine) or equivalent device.

### 4.3. Block diagram(LCD Module)



## 4.4. Backlight driving

CN103 (+24V DC power supply and inverter control)

Using connector: S14B-PH-K-S (LF) (JST)

Mating connector: PHR-14 (JST)

| Pin No. | Symbol               | Function                                      | Default(OPEN)                         | Input Impedance | Remark   |
|---------|----------------------|-----------------------------------------------|---------------------------------------|-----------------|----------|
| 1       | V <sub>INV</sub>     | +24V                                          | -                                     |                 |          |
| 2       | V <sub>INV</sub>     | +24V                                          | -                                     |                 |          |
| 3       | V <sub>INV</sub>     | +24V                                          | -                                     |                 |          |
| 4       | V <sub>INV</sub>     | +24V                                          | -                                     |                 |          |
| 5       | V <sub>INV</sub>     | +24V                                          | -                                     |                 |          |
| 6       | GND                  |                                               | -                                     |                 |          |
| 7       | GND                  |                                               | -                                     |                 |          |
| 8       | GND                  |                                               | -                                     |                 |          |
| 9       | GND                  |                                               | -                                     |                 |          |
| 10      | GND                  |                                               | -                                     |                 |          |
| 11      | Reserved             | For LCD module internal usage, should be open |                                       |                 |          |
| 12      | V <sub>ON</sub>      | Inverter ON/OFF                               | GND : pull down<br>Inverter OFF       | 22K ohm         | [Note 1] |
| 13      | V <sub>BRT</sub>     | Brightness Control                            | 3.3V : pull up<br>Brightness 100%     | 100K ohm        | [Note 3] |
| 14      | V <sub>BRT_sel</sub> | Brightness Control selection                  | 3.3V : pull up<br>Selected Analog PWM | 100K ohm        | [Note 2] |

\*GND of an inverter board is not connected to GND of a module chassis and a liquid crystal panel drive part.

CN104(+24V DC power supply)

Using connector: S14B-PH-K-S(LF) (JST)

Mating connector: PHR-14 (JST)

| Pin No. | Symbol           | Function                                      | Default(OPEN) | Input Impedance | Remark |
|---------|------------------|-----------------------------------------------|---------------|-----------------|--------|
| 1       | V <sub>INV</sub> | +24V                                          | -             |                 |        |
| 2       | V <sub>INV</sub> | +24V                                          | -             |                 |        |
| 3       | V <sub>INV</sub> | +24V                                          | -             |                 |        |
| 4       | V <sub>INV</sub> | +24V                                          | -             |                 |        |
| 5       | V <sub>INV</sub> | +24V                                          | -             |                 |        |
| 6       | GND              |                                               | -             |                 |        |
| 7       | GND              |                                               | -             |                 |        |
| 8       | GND              |                                               | -             |                 |        |
| 9       | GND              |                                               | -             |                 |        |
| 10      | GND              |                                               | -             |                 |        |
| 11      | Reserved         | For LCD module internal usage, should be open |               |                 |        |
| 12      | Reserved         | For LCD module internal usage, should be open |               |                 |        |
| 13      | Reserved         | For LCD module internal usage, should be open | -             |                 |        |
| 14      | Reserved         | For LCD module internal usage, should be open | -             |                 |        |

[Note 1] Inverter ON/OFF

| Input voltage | Function       |
|---------------|----------------|
| 0V            | Inverter : OFF |
| 3.3V          | Inverter : ON  |

[Note 2] Brightness Control selection

Pin No.14 is used for the selection of dimming control for  $V_{BRT}$  pin (Pin No.13).

| Input voltage | $V_{BRT}$      |
|---------------|----------------|
| 0V            | Pulse dimming  |
| 3.3V          | Analog dimming |

[Note 3] Brightness Control

#### 1. Analog Dimming

Brightness control is regulated by analog input voltage (0V to 3.3V).

$T_a=25^{\circ}\text{C}$

|                                     | MIN | TYP | MAX  | Function                |
|-------------------------------------|-----|-----|------|-------------------------|
| Input voltage [ $V_{BRT}$ ]         | 0V  | <-> | 3.3V | 0V: Dark - 3.3V: Bright |
| [Reference]<br>Brightness ratio [%] | 20  | <-> | 100  |                         |

[Note] PWM frequency :  $275\pm 10\text{Hz}$

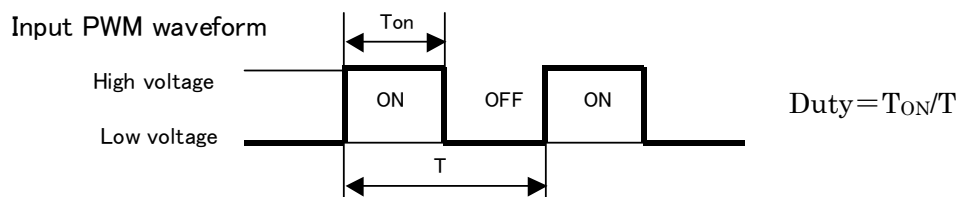
[Note] There is a case that lamp mura may happen, depending on ambient temperature and dimming.

Dimming level should be set according to your evaluation of actual display performance.

(Minimum input voltage 1.5V at below  $15^{\circ}\text{C}$ )

#### 2. Pulse Dimming

Pin No.13 is used for the control of the PWM duty with input pulse from 150Hz to 350Hz.



|                                     |      | MIN | TYP | MAX | Remark                                         |
|-------------------------------------|------|-----|-----|-----|------------------------------------------------|
| Pulse signal                        | [Hz] | 150 | 275 | 350 |                                                |
| DUTY( $T_{ON}/T$ )                  | [%]  | 35  | <-> | 100 | $T_a=25^{\circ}\text{C}$                       |
| Dimming level<br>(Brightness ratio) | [%]  | 20  | <-> | 100 | $T_a=25^{\circ}\text{C}$<br>Pulse signal=275Hz |

[Note] There is a case that lamp mura may happen, depending on ambient temperature, in dimming. Minimum dimming level should be set according to your evaluation of actual display performance. (Minimum duty 60% at below  $15^{\circ}\text{C}$ )

[Note] In case of using Pulse Dimming, be careful so that the  $V_{BRT}$  signal (Pin 13) doesn't have glitch.

#### 4.5. The back light system characteristics

The back light system is direct type with 24 CCFTs (Cold Cathode Fluorescent Tube).

The characteristics of the lamp are shown in the following table. The value mentioned below is at the case of one CCFT.

| Item      | Symbol         | Min. | Typ.  | Max. | Unit | Remarks |
|-----------|----------------|------|-------|------|------|---------|
| Life time | T <sub>L</sub> | -    | 60000 | -    | Hour | [Note]  |

[Note]

- Lamp life time is defined as the time when brightness becomes 50% of the original value in the continuous operation under the condition of Ta=25°C and brightness control(V<sub>BRT</sub>=100%).
- Above value is applicable when the long side of LCD module is placed horizontally (Landscape position). (Lamp lifetime may vary if LCD module is in portrait position due to the change of mercury density inside the lamp.)

### 5. Absolute Maximum Ratings

| Parameter                            | Symbol                                                      | Condition | Ratings    | Unit | Remark   |
|--------------------------------------|-------------------------------------------------------------|-----------|------------|------|----------|
| Input voltage<br>(for Control)       | V <sub>I</sub>                                              | Ta=25 °C  | -0.3 ~ 3.6 | V    | [Note 1] |
| 12V supply voltage<br>(for Control)  | VCC                                                         | Ta=25 °C  | 0 ~ + 14   | V    |          |
| Input voltage<br>(for Inverter)      | V <sub>ON</sub><br>V <sub>BRT</sub><br>V <sub>BRT_sel</sub> | Ta=25 °C  | 0 ~ + 6    | V    |          |
| 24V supply voltage<br>(for Inverter) | V <sub>INV</sub>                                            | Ta=25 °C  | 0 ~ +29    | V    |          |
| Storage temperature                  | Tstg                                                        | -         | -25 ~ +60  | °C   | [Note 2] |
| Operation temperature<br>(Ambient)   | Topa                                                        | -         | 0 ~ +50    | °C   |          |

[Note 1] SELVDS, FRAME, O/S\_set,

[Note 2] Humidity 95%RH Max.(Ta≤40°C)

Maximum wet-bulb temperature at 39 °C or less.(Ta>40°C)

No condensation.

## 6. Electrical Characteristics

### 6.1. Control circuit driving

Ta=25 °C

| Parameter                            |                     | Symbol            | Min. | Typ. | Max. | Unit              | Remark                              |
|--------------------------------------|---------------------|-------------------|------|------|------|-------------------|-------------------------------------|
| +12V supply voltage                  | Supply voltage      | V <sub>CC</sub>   | 11.4 | 12   | 12.6 | V                 | [Note 1]                            |
|                                      | Current dissipation | I <sub>CC</sub>   | -    | 1.1  | 3.0  | A                 | [Note 2]                            |
|                                      | Inrush current      | I <sub>RUSH</sub> | -    | 13   | -    | A                 | [Note 7]                            |
|                                      |                     | T <sub>RUSH</sub> | -    | 100  | -    | us                |                                     |
| Permissible input ripple voltage     |                     | V <sub>RP</sub>   | -    | -    | 100  | mV <sub>P-P</sub> | V <sub>CC</sub> = +12.0V            |
| Differential input threshold voltage | High                | V <sub>TH</sub>   | -    | -    | 100  | mV                | V <sub>CM</sub> = +1.2V<br>[Note 6] |
|                                      | Low                 | V <sub>TL</sub>   | -100 | -    | -    | mV                |                                     |
| Input Low voltage                    |                     | V <sub>IL</sub>   | 0    | -    | 1.0  | V                 | [Note 3]                            |
| Input High voltage                   |                     | V <sub>IH</sub>   | 2.3  | -    | 3.3  | V                 |                                     |
| Input leak current (Low)             |                     | I <sub>IL1</sub>  | -    | -    | 400  | μA                | V <sub>I</sub> = 0V<br>[Note 4]     |
|                                      |                     | I <sub>IL2</sub>  | -    | -    | 40   | μA                | V <sub>I</sub> = 0V<br>[Note 5]     |
| Input leak current (High)            |                     | I <sub>IH1</sub>  | -    | -    | 40   | μA                | V <sub>I</sub> = 3.3V<br>[Note 4]   |
|                                      |                     | I <sub>IH2</sub>  | -    | -    | 400  | μA                | V <sub>I</sub> = 3.3V<br>[Note 5]   |
| Terminal resistor                    |                     | R <sub>T</sub>    | -    | 100  | -    | Ω                 | Differential input                  |

[Note] V<sub>CM</sub>: Common mode voltage of LVDS driver.

[Note 1]

Input voltage sequences

$$0 < t_1 \leq 20\text{ms}$$

$$10 < t_2 \leq 20\text{ms}$$

$$10 < t_3 \leq 50\text{ms}$$

$$0 < t_4 \leq 1\text{s}$$

$$t_5 \geq 200\text{ms}$$

$$t_6 \geq 0$$

$$t_7 \geq 300\text{ms}$$

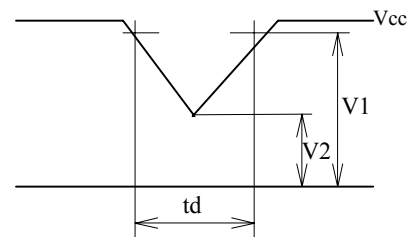
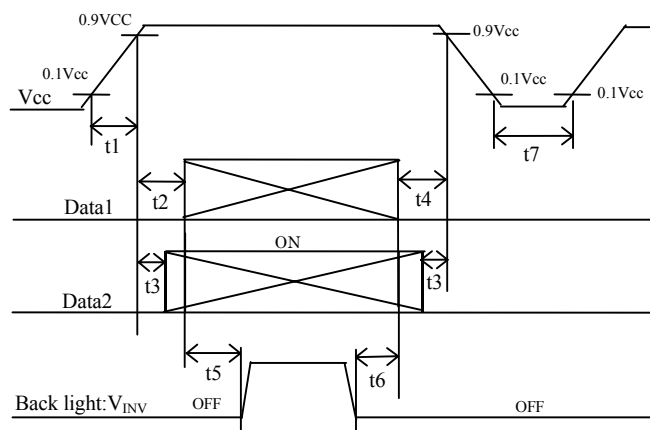
Dip conditions for supply voltage

$$\text{a) } 6.5\text{V} \leq V_{CC} < 10.8\text{V}$$

$$t_d \leq 10\text{ms}$$

$$\text{b) } V_{CC} < 6.5\text{V}$$

Dip conditions for supply voltage is based on input voltage sequence.



V1:10.8V  
V2:6.5V

※ Data1: ACK±, AIN0±, AIN1±, AIN2±, AIN3±, AIN4±, BCK±, BIN0±, BIN1±, BIN2±, BIN3±, BIN4±

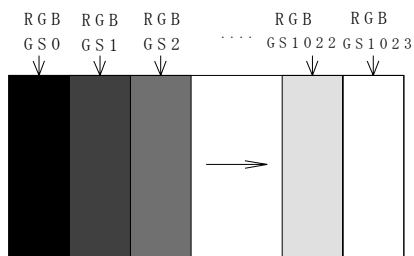
\*V<sub>CM</sub> voltage pursues the sequence mentioned above

※ Data2: SELLVDS, FRAME, O/S\_SET

[Note] About the relation between data input and back light lighting, please base on the above-mentioned input sequence. When back light is switched on before panel operation or after a panel operation stop, it may not display normally. But this phenomenon is not based on change of an incoming signal, and does not give damage to a liquid crystal display.

[Note 2] Typical current situation: 1024 gray-bar patterns. ( $V_{CC} = +12.0V$ )

The explanation of RGB gray scale is seen in section 8.



$V_{CC} = +12.0V$   
 $CK = 74.25MHz$   
 $Th = 7.41\mu s$

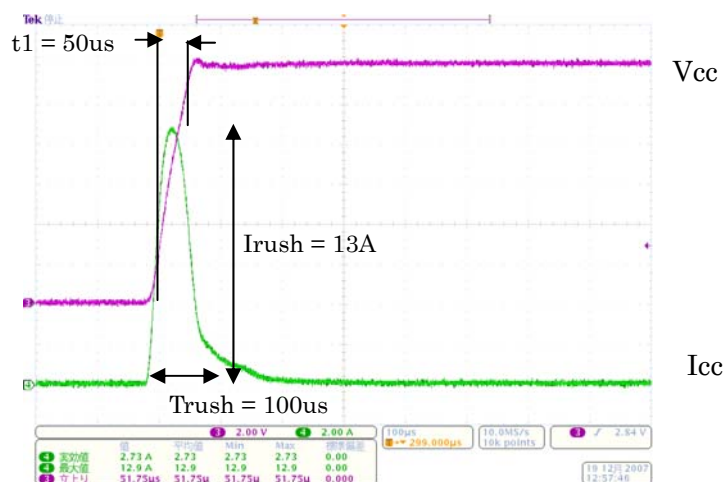
[Note 3] SELLVDS, FRAME, O/S\_SET

[Note 4] O/S\_SET

[Note 5] FRAME, SELLVDS

[Note 6]  $ACK\pm$ ,  $AIN0\pm$ ,  $AIN1\pm$ ,  $AIN2\pm$ ,  $AIN3\pm$ ,  $AIN4\pm$ ,  $BCK\pm$ ,  $BIN0\pm$ ,  $BIN1\pm$ ,  $BIN2\pm$ ,  $BIN3\pm$ ,  $BIN4\pm$

[Note 7]  $V_{CC}12V$  inrush current waveform

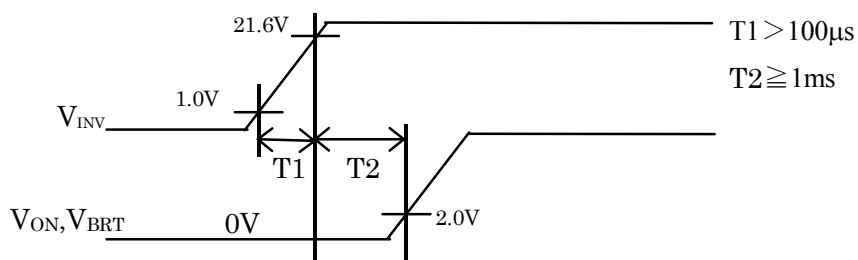


## 6.2. Inverter driving for back light

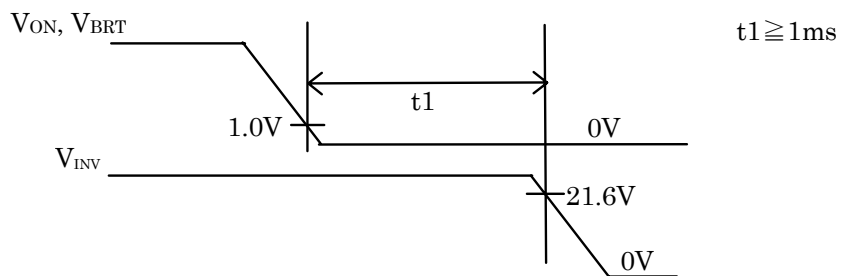
The back light system is direct type with 24 CCFTs (Cold Cathode Fluorescent Tube).

| Parameter                        |                       | Symbol | Min. | Typ. | Max. | Unit  | Remark                                           |
|----------------------------------|-----------------------|--------|------|------|------|-------|--------------------------------------------------|
| +24V                             | Current dissipation 1 | IINV 1 | -    | 11.8 | 13.0 | A     | VINV = 24V, Ta=25°C<br>VBRT = 3.3V<br>[Note 1,2] |
|                                  | Current dissipation 2 | IINV 2 | -    | 10.3 | 11.5 | A     |                                                  |
|                                  | Supply voltage        | VINV   | 22.8 | 24.0 | 25.2 | V     |                                                  |
| Permissible input ripple voltage |                       | VRF    | -    | -    | 300  | mVp-p | VINV = +24.0V                                    |
| Input voltage (Low)              |                       | VONL   | 0    | -    | 1.0  | V     | VON,VBRT, VBRT_sel                               |
| Input voltage (High)             |                       | VONH   | 2.3  | -    | 3.6  | V     |                                                  |

[Note 1] 1) V<sub>INV</sub>-turn-on condition



2) V<sub>INV</sub>-turn-off condition



[Note 2] Current dissipation 1 : Definition within 60 minutes after turn on. (Rush current is excluded.)

Current dissipation 2 : Definition more than 60minutes after turn on.

## 7. Timing characteristics of input signals

### 7.1. Timing characteristics

Timing diagrams of input signal are shown in Fig.2.

| Parameter          |                          | Symbol | Min.   | Typ.  | Max.   | Unit  | Remark |
|--------------------|--------------------------|--------|--------|-------|--------|-------|--------|
| Clock              | Frequency                | 1/Tc   | 55     | 74.25 | 80     | MHz   |        |
| Data enable signal | Horizontal period        | TH     | 515    | 550   | 825    | clock |        |
|                    |                          |        | 6.94   | 7.41  | 11.1   | μs    |        |
|                    | Horizontal period (High) | THd    | 480    | 480   | 480    | clock |        |
|                    | Vertical period          | TV     | 1120   | 1125  | 1232   | line  |        |
|                    |                          |        | 73.052 | 120   | 120.54 | Hz    |        |
|                    | Vertical period (High)   | TVd    | 1080   | 1080  | 1080   | line  |        |

[Note]-When vertical period is very long, flicker and etc. may occur.

-Please turn off the module after it shows the black screen.

-As for your final setting of driving timing, we will conduct operation check test at our side, please inform your final setting.

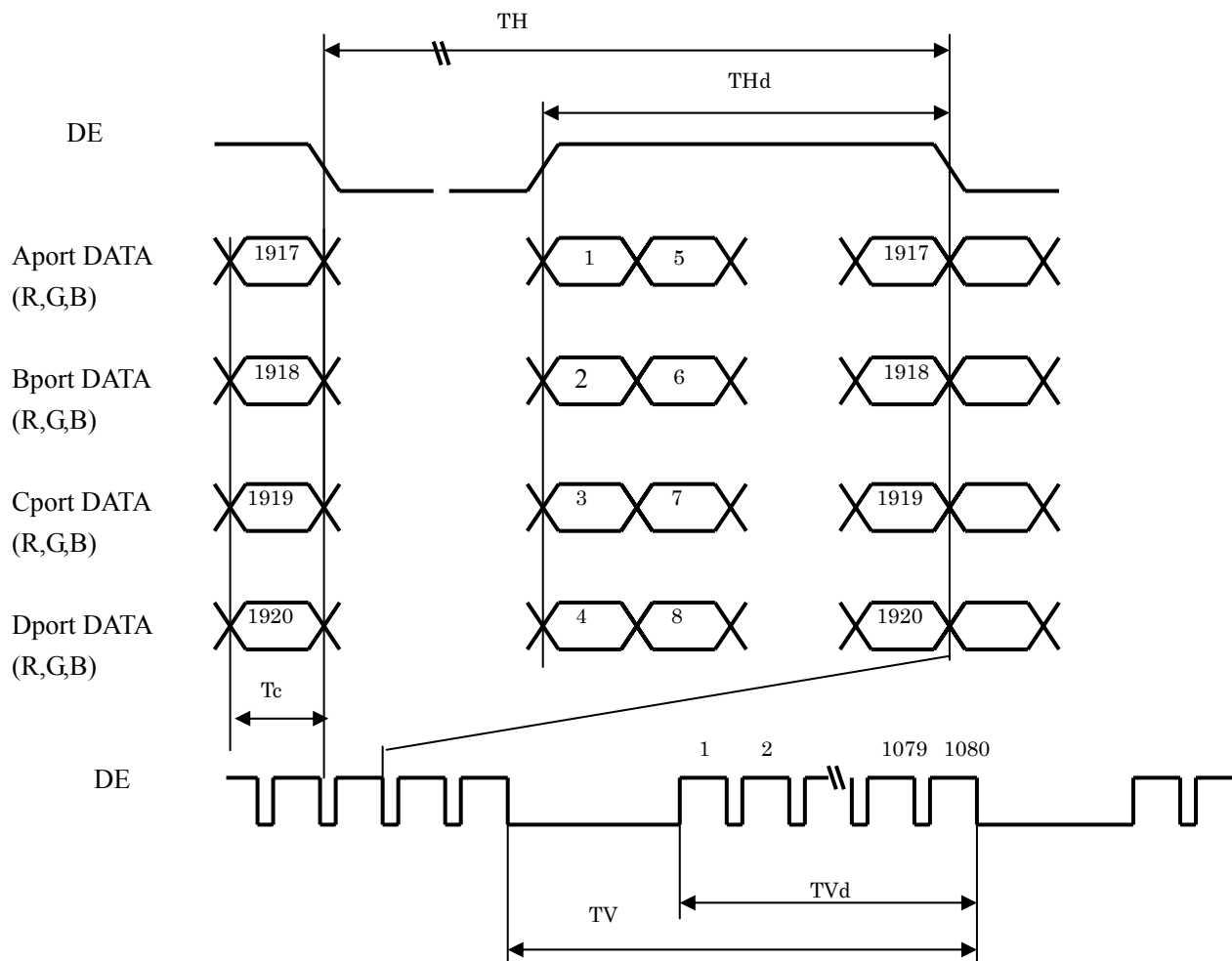
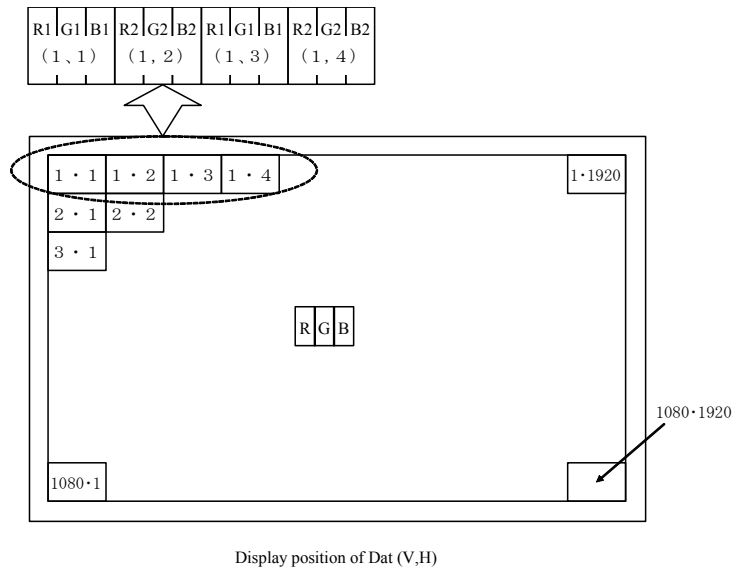


Fig.2 Timing characteristics of input signals



## 7.2. Input data signal and display position on the screen



## 8. Input Signal, Basic Display Colors and Gray Scale of Each Color

|                     |                     | Data signal |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |   |
|---------------------|---------------------|-------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|---|
|                     | Colors & Gray scale | Gray Scale  | R0 | R1 | R2 | R3 | R4 | R5 | R6 | R7 | R8 | R9 | G0 | G1 | G2 | G3 | G4 | G5 | G6 | G7 | G8 | G9 | B0 | B1 | B2 | B3 | B4 | B5 | B6 | B7 | B8 | B9 |   |
|                     |                     |             |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |   |
| Basic Color         | Black               | —           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |   |
|                     | Blue                | —           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |   |
|                     | Green               | —           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |   |
|                     | Cyan                | —           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |   |
|                     | Red                 | —           | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |   |
|                     | Magenta             | —           | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1 |
|                     | Yellow              | —           | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |   |
|                     | White               | —           | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |   |
| Gray Scale of Red   | Black               | GS0         | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |   |
|                     | ⇧                   | GS1         | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |   |
|                     | Darker              | GS2         | 0  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |   |
|                     | ⇧                   | ↓           | ↓  |    |    |    |    |    |    |    |    |    | ↓  |    |    |    |    |    |    |    |    |    | ↓  |    |    |    |    |    |    |    |    |    |   |
|                     | ⇩                   | ↓           | ↓  |    |    |    |    |    |    |    |    |    | ↓  |    |    |    |    |    |    |    |    |    | ↓  |    |    |    |    |    |    |    |    |    |   |
|                     | Brighter            | GS1021      | 1  | 0  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |   |
|                     | ⇩                   | GS1022      | 0  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |   |
|                     | Red                 | GS1023      | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |   |
| Gray Scale of Green | Black               | GS0         | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |   |
|                     | ⇧                   | GS1         | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |   |
|                     | Darker              | GS2         | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |   |
|                     | ⇧                   | ↓           | ↓  |    |    |    |    |    |    |    |    |    | ↓  |    |    |    |    |    |    |    |    |    | ↓  |    |    |    |    |    |    |    |    |    |   |
|                     | ⇩                   | ↓           | ↓  |    |    |    |    |    |    |    |    |    | ↓  |    |    |    |    |    |    |    |    |    | ↓  |    |    |    |    |    |    |    |    |    |   |
|                     | Brighter            | GS1021      | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 0  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |   |
|                     | ⇩                   | GS1022      | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |   |
|                     | Green               | GS1023      | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |   |
| Gray Scale of Blue  | Black               | GS0         | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |   |
|                     | ⇧                   | GS1         | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |   |
|                     | Darker              | GS2         | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |   |
|                     | ⇩                   | ↓           | ↓  |    |    |    |    |    |    |    |    |    | ↓  |    |    |    |    |    |    |    |    |    | ↓  |    |    |    |    |    |    |    |    |    |   |
|                     | ⇩                   | ↓           | ↓  |    |    |    |    |    |    |    |    |    | ↓  |    |    |    |    |    |    |    |    |    | ↓  |    |    |    |    |    |    |    |    |    |   |
|                     | Brighter            | GS1021      | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 0  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |   |
|                     | ⇩                   | GS1022      | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |   |
|                     | Blue                | GS1023      | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |   |

0: Low level voltage, 1: High level voltage.

Each basic color can be displayed in 1024 gray scales from 10 bits data signals. According to the combination of total 30 bits data signals, one billion -color display can be achieved on the screen.

## 9. Optical characteristics

$T_a=25^{\circ}\text{C}$ ,  $V_{cc}=12.0\text{V}$ ,  $V_{INV}=24.0\text{V}$ ,  $V_{BRT}=100\%$ , Timing:60Hz(typ. value)

| Parameter            |            | Symbol                         | Condition          | Min.  | Typ.  | Max.  | Unit            | Remark      |
|----------------------|------------|--------------------------------|--------------------|-------|-------|-------|-----------------|-------------|
| Viewing angle range  | Horizontal | $\theta_{21}$<br>$\theta_{22}$ | $CR \geq 10$       | 70    | 88    | -     | Deg.            | [Note1,4]   |
|                      | Vertical   | $\theta_{11}$<br>$\theta_{12}$ |                    | 70    | 88    | -     | Deg.            |             |
| Contrast ratio       |            | CRn                            | $\theta=0^{\circ}$ | 1200  | 1800  | -     |                 | [Note2,4]   |
| Response time        |            | $\tau_r$<br>$\tau_d$           |                    | -     | 4     | -     | ms              | [Note3,4,5] |
| Chromaticity         | White      | x                              |                    | 0.242 | 0.272 | 0.302 | -               | [Note4]     |
|                      |            | y                              |                    | 0.247 | 0.277 | 0.307 | -               |             |
|                      | Red        | x                              |                    | 0.610 | 0.640 | 0.670 | -               |             |
|                      |            | y                              |                    | 0.300 | 0.330 | 0.360 | -               |             |
|                      | Green      | x                              |                    | 0.250 | 0.280 | 0.310 | -               |             |
|                      |            | y                              |                    | 0.570 | 0.600 | 0.630 | -               |             |
|                      | Blue       | x                              |                    | 0.120 | 0.150 | 0.180 | -               |             |
|                      |            | y                              |                    | 0.030 | 0.060 | 0.090 | -               |             |
| Luminance            | White      | $Y_L$                          |                    | 360   | 450   | -     | $\text{cd/m}^2$ |             |
| Luminance uniformity | White      | $\delta w$                     |                    | -     | -     | 1.25  | -               | [Note 6]    |

Measurement condition: Set the value of  $V_{BRT}$  to maximum luminance of white.

\*The measurement shall be executed 60 minutes after lighting at rating.

[Note]The optical characteristics are measured using the following equipment.

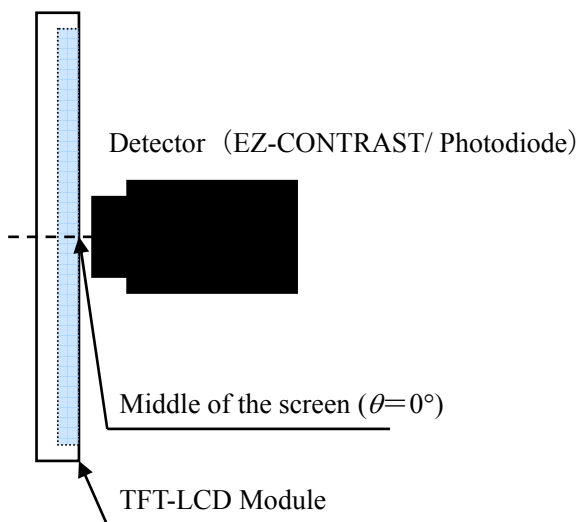


Fig.4-1 Measurement of viewing angle range and Response time.

Viewing angle range: EZ-CONTRAST

Response time: Photodiode

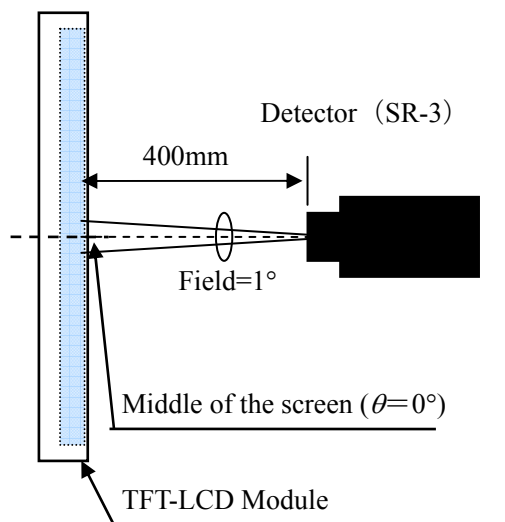
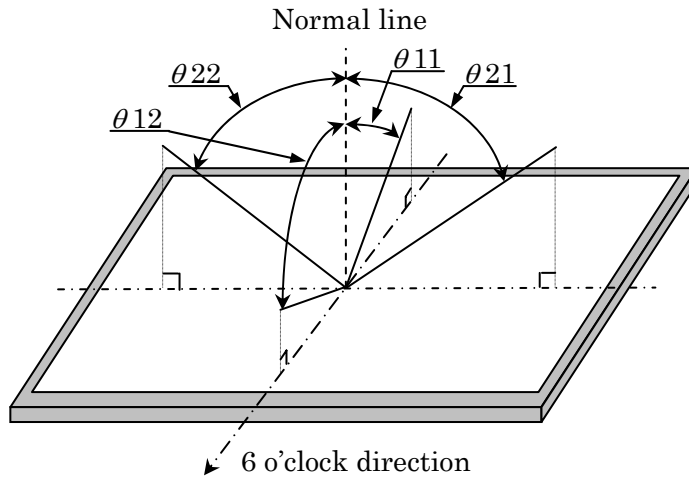


Fig.4-2 Measurement of Contrast, Luminance, Chromaticity.

[Note 1]Definitions of viewing angle range



[Note 2]Definition of contrast ratio :

The contrast ratio is defined as the following.

$$\text{Contrast Ratio} = \frac{\text{Luminance (brightness) with all pixels white}}{\text{Luminance (brightness) with all pixels black}}$$

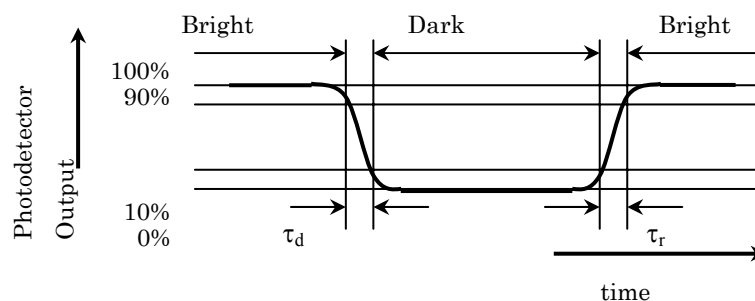
[Note 3]Definition of response time

The response time ( $\tau_d$  and  $\tau_r$ ) is defined as the following figure and shall be measured by switching the input signal for “any level of gray (0%, 25%, 50%, 75% and 100%)” and “any level of gray (0%, 25%, 50%, 75% and 100%)”.

|      | 0%          | 25%          | 50%          | 75%         | 100%         |
|------|-------------|--------------|--------------|-------------|--------------|
| 0%   |             | tr:0%-25%    | tr:0%-50%    | tr:0%-75%   | tr:0%-100%   |
| 25%  | td: 25%-0%  |              | tr: 25%-50%  | tr:25%-75%  | tr: 25%-100% |
| 50%  | td: 50%-0%  | td: 50%-25%  |              | tr: 50%-75% | tr: 50%-100% |
| 75%  | td: 75%-0%  | td: 75%-25%  | td: 75%-50%  |             | tr: 75%-100% |
| 100% | td: 100%-0% | td: 100%-25% | td: 100%-50% | td:100%-75% |              |

$t^*:x-y$ ...response time from level of gray(x) to level of gray(y)

$$\tau_r = \Sigma(\text{tr}:x-y)/10, \tau_d = \Sigma(\text{td}:x-y)/10$$



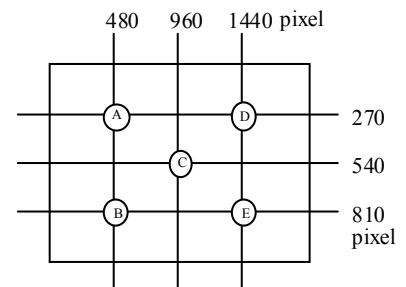
[Note 4]This shall be measured at center of the screen.

[Note 5] This value is valid when O/S driving is used at typical input time value.

[Note 6]Definition of white uniformity ;

White uniformity is defined as the following with five measurements. (A~E)

$$\delta_w = \frac{\text{Maximum luminance of five points (brightness)}}{\text{Minimum luminance of five points (brightness)}}$$



## 10. Handling Precautions of the module

- Be sure to turn off the power supply when inserting or disconnecting the cable.
- This product is using the parts (inverter, CCFT etc), which generate the high voltage.

Therefore, during operating, please don't touch these parts.

- Brightness control voltage is switched for “ON” and “OFF”, as shown in Fig.4. Voltage difference generated by this switching,  $\Delta V_{INV}$ , may affect a sound output, etc. when the power supply is shared between the inverter and its surrounding circuit. So, separate the power supply of the inverter circuit with the one of its surrounding circuit.

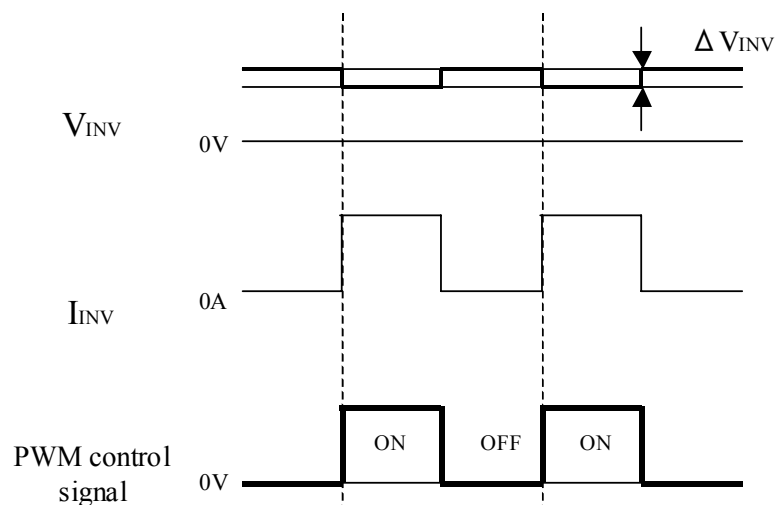


Fig.4 Brightness control voltage.

\*Since inverter board's GND is not connected to the frame of the LCD module, please connect it with the Customer's GND of inverter power supply.

- Be sure to design the cabinet so that the module can be installed without any extra stress such as warp or twist.
- Since the front polarizer is easily damaged, pay attention not to scratch it.
- Since long contact with water may cause discoloration or spots, wipe off water drop immediately.
- When the panel surface is soiled, wipe it with absorbent cotton or other soft cloth.
- Since the panel is made of glass, it may break or crack if dropped or bumped on hard surface. Handle with care.

- i) Since CMOS LSI is used in this module, take care of static electricity and take the human earth into consideration when handling.
- j) The module has some printed circuit boards (PCBs) on the back side, take care to keep them from any stress or pressure when handling or installing the module; otherwise some of electronic parts on the PCBs may be damaged.
- k) Observe all other precautionary requirements in handling components.
- l) When some pressure is added onto the module from rear side constantly, it causes display non-uniformity issue, functional defect, etc. So, please avoid such design.
- m) When giving a touch to the panel at power on supply, it may cause some kinds of degradation. In that case, once turn off the power supply, and turn on after several seconds again, and that is disappear.
- n) When handling LCD modules and assembling them into cabinets, please be noted that long-term storage in the environment of oxidization or deoxidization gas and the use of such materials as reagent, solvent, adhesive, resin, etc. which generate these gasses, may cause corrosion and discoloration of the LCD modules.
- o) This LCD module is designed to prevent dust from entering into it. However, there would be a possibility to have a bad effect on display performance in case of having dust inside of LCD module. Therefore, please ensure to design your TV set to keep dust away around LCD module.

## 11. Packing form

- a) Piling number of cartons:2 maximum
- b) Packing quantity in one carton:8pcs
- c) Carton size:1320(W) × 1110(D) × 940(H)
- d) Total mass of one carton filled with full modules:225kg(Max)

## 12. Reliability test item

| No. | Test item                                         | Condition                                                                                                                                                                                                                                                                                                    |
|-----|---------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1   | High temperature storage test                     | Ta=60°C 240h                                                                                                                                                                                                                                                                                                 |
| 2   | Low temperature storage test                      | Ta=-25°C 240h                                                                                                                                                                                                                                                                                                |
| 3   | High temperature and high humidity operation test | Ta=40°C ; 95%RH 240h<br>(No condensation)                                                                                                                                                                                                                                                                    |
| 4   | High temperature operation test                   | Ta=50°C 240h                                                                                                                                                                                                                                                                                                 |
| 5   | Low temperature operation test                    | Ta=0°C 240h                                                                                                                                                                                                                                                                                                  |
| 6   | Vibration test<br>(non-operation)                 | Frequency: 10~57Hz/Vibration width (one side): 0.075mm<br>: 58~500Hz/Acceleration: 9.8 m/s <sup>2</sup><br>Sweep time: 11 minutes<br>Test period: 3 hours (1h for each direction of X, Y, Z)                                                                                                                 |
| 7   | Shock test<br>(non-operation)                     | Maximum acceleration: 294m/s <sup>2</sup><br>Pulse width: 11ms, sinusoidal half wave<br>Direction: +/-X, +/-Y, +/-Z, once for each direction.                                                                                                                                                                |
| 8   | ESD                                               | * At the following conditions, it is a thing without incorrect operation and destruction.<br>(1)Non-operation: Contact electric discharge ±10kV<br>Non-contact electric discharge ±20kV<br>(2)Operation Contact electric discharge ±8kV<br>Non-contact electric discharge ±15kV<br>Conditions: 150pF, 330ohm |

[Result evaluation criteria]

Under the display quality test condition with normal operation state, there shall be no change, which may affect practical display function.

### 13. Others

#### 1) Lot No. Label ;

The label that displays SHARP, product model (LK520D3LZ97), a product number is stuck on the back of the module.

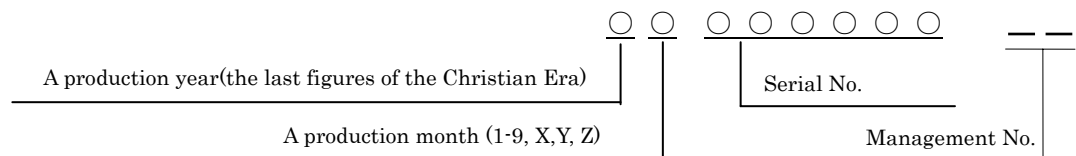
【LK520D3LZ97X, T】 NSEC PRODUCTION



【LK520D3LZ97Z, V】 SEMEX PRODUCTION



How to express Lot No.



#### 2) Packing Labe

【LK520D3LZ97X, T】

|                                    |  |
|------------------------------------|--|
| 社内品番 : ( 4 S ) LK520D3LZ97X(orT) ① |  |
| Bar code                           |  |
| Lot NO. (1 T) 2007. *.** ②         |  |
| Bar code                           |  |
| Quantity : (Q) 8 p c s ③           |  |
| Bar code                           |  |
| ユーザ品番 .                            |  |
| シャープ物流用ラベルです。                      |  |

【LK520D3LZ97Z, V】

|                                    |  |
|------------------------------------|--|
| 社内品番 : ( 4 S ) LK520D3LZ97Z(orV) ① |  |
| Bar code                           |  |
| Lot NO. (1 T) 2007. *.** ②         |  |
| Bar code                           |  |
| Quantity : (Q) 8 p c s ③           |  |
| Bar code                           |  |
| ユーザ品番 .                            |  |
| シャープ物流用ラベルです。                      |  |

① Management No.

② Lot No. (Date)

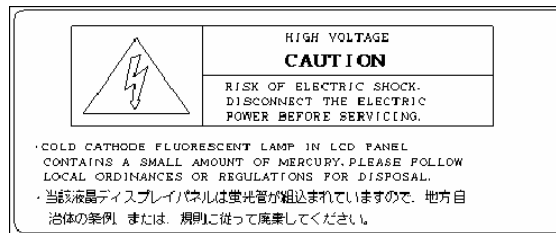
③ Quantity

#### 3) Adjusting volume has been set optimally before shipment, so do not change any adjusted value.

If adjusted value is changed, the specification may not be satisfied.

#### 4) Disassembling the module can cause permanent damage and should be strictly avoided.

- 5) Please be careful since image retention may occur when a fixed pattern is displayed for a long time.
- 6) The chemical compound, which causes the destruction of ozone layer, is not being used.
- 7) Cold cathode fluorescent lamp in LCD PANEL contains a small amount of mercury. Please follow local ordinances or regulations for disposal. This sentence is displayed on the backside of the module.



- 9) Rust on the module is not taken up a problem.
- 10) C-PWB must be on upper side of LCD module when it is in the TV-set.
- \*:Please inform SHARP if C-PWB is at bottom side of LCD module when it is in the TV-set
- 11) This module is corresponded to RoHS.

## 14. Carton storage condition

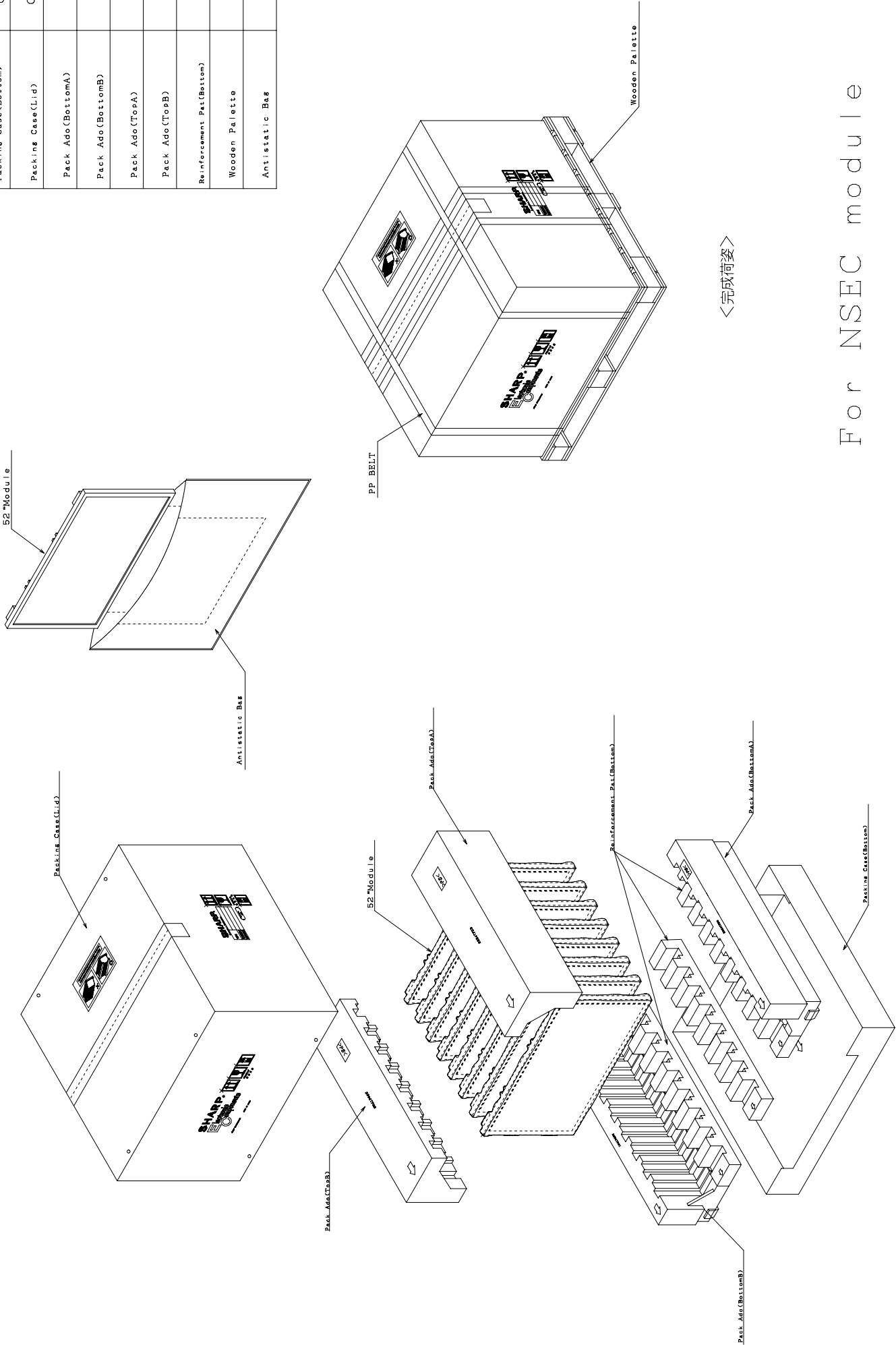
|                     |                                                                                                                                                                                                                                                        |
|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Temperature         | 0°C to 40°C                                                                                                                                                                                                                                            |
| Humidity            | 95%RH or less                                                                                                                                                                                                                                          |
| Reference condition | : 20°C to 35°C, 85%RH or less (summer)<br>: 5°C to 15°C, 85%RH or less (winter)<br>• the total storage time (40°C,95%RH) : 240H or less                                                                                                                |
| Sunlight            | Be sure to shelter a product from the direct sunlight.                                                                                                                                                                                                 |
| Atmosphere          | Harmful gas, such as acid and alkali which bites electronic components and/or wires must not be detected.                                                                                                                                              |
| Notes               | Be sure to put cartons on palette or base, don't put it on floor, and store them with removing from wall<br>Please take care of ventilation in storehouse and around cartons, and control changing temperature is within limits of natural environment |
| Storage life        | 1 year                                                                                                                                                                                                                                                 |





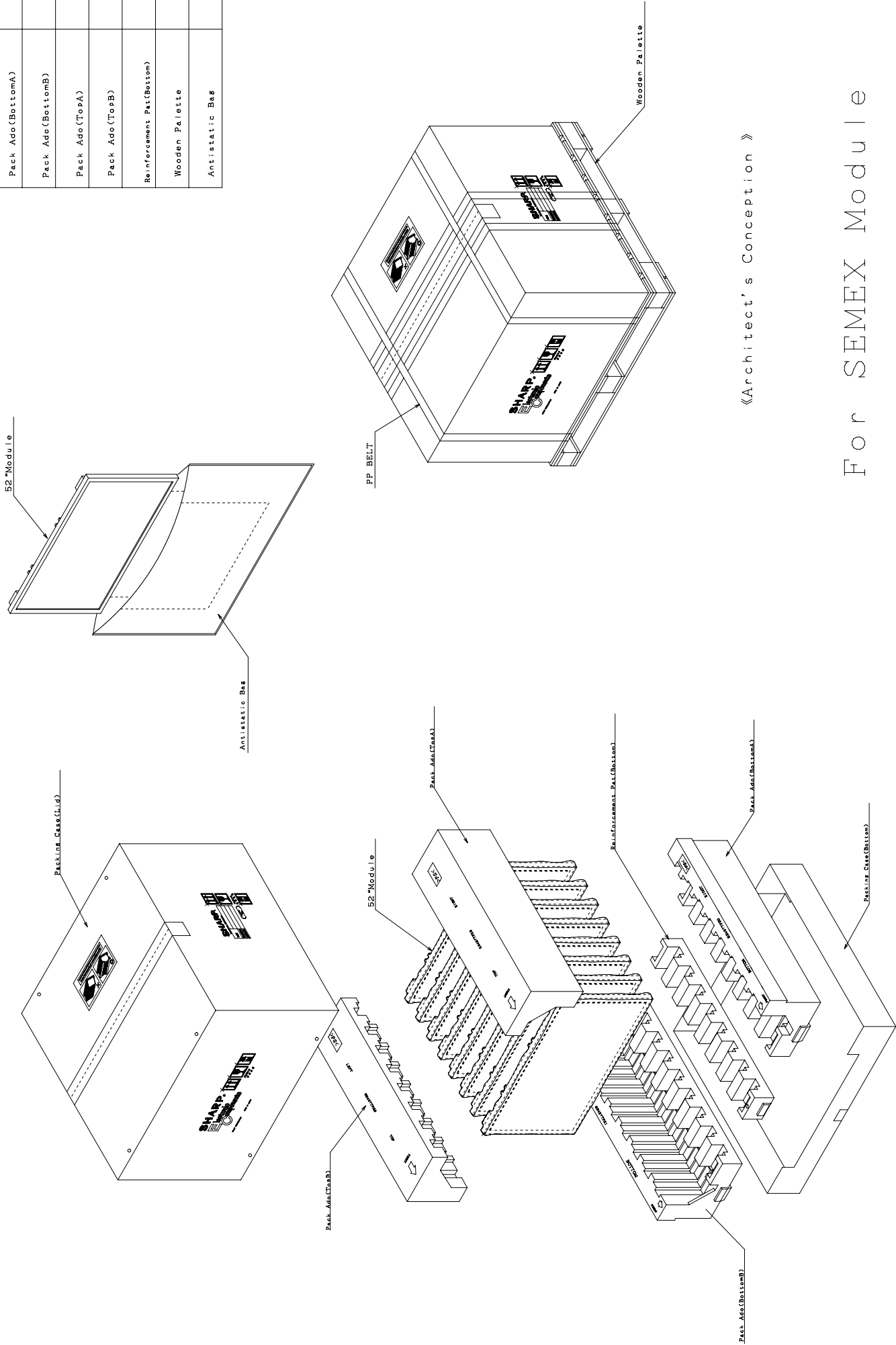
LK520D3LZ97

| Parts Name                | Material  |
|---------------------------|-----------|
| Packing Case(Bottom)      | Cardboard |
| Packing Case(Lid)         | Cardboard |
| Pack Ado(BottomA)         | PS        |
| Pack Ado(BottomB)         | PS        |
| Pack Ado(TopA)            | PS        |
| Pack Ado(TopB)            | PS        |
| Reinforcement Pat(Bottom) | PS        |
| Wooden Palette            | Plywood   |
| Antistatic Bag            | PE        |



For NSEC module

| Parts Name                | Material  |
|---------------------------|-----------|
| Packing Case(Bottom)      | Cardboard |
| Packing Case(Lid)         | Cardboard |
| Pack Ado(BottomA)         | PS        |
| Pack Ado(BottomB)         | PS        |
| Pack Ado(TopA)            | PS        |
| Pack Ado(TopB)            | PS        |
| Reinforcement Pad(Bottom) | PS        |
| Wooden Palette            | Plywood   |
| Antistatic Bag            | PE        |



《Architect's Conception》

For SEMEX Module

|          |           |
|----------|-----------|
| File No. | LDK-145E  |
| ISSUE    | 19-Dec-07 |
| PAGE     | 10page    |

TO : \_\_\_\_\_

## Incoming Inspection Standards

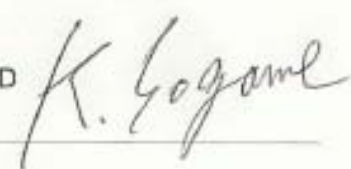
Product **TFT-LCD Module**

Model **LK520D3LZ97**

☐ CUSTOMER'S APPROVAL

DATE \_\_\_\_\_

BY \_\_\_\_\_

PRESENTED BY 

K.Sogame  
DEPARTMENT GENERAL MANAGER  
QUALITY ASSURANCE DEPT.  
AVC LIQUID CRYSTAL DISPLAY GROUP  
SHARP CORPORATION

## Records of Revision

| Standards No. | Revision Date | Rev. Mark | Contents of Revision                                              |
|---------------|---------------|-----------|-------------------------------------------------------------------|
| LDK-145E      | 19-Dec-07     |           | - first Edition                      Model Addition : LK520D3LZ97 |
|               |               |           |                                                                   |



**Applicable Model List**

This grade inspection standard applies to the models as below

| Applicable Model |  | Revision Mark |
|------------------|--|---------------|
| LK520D3LZ97      |  |               |
|                  |  |               |

## Incoming Inspection for TFT-LCD Module

### 1. Scope

- These Incoming Inspection Standards shall apply to TFT-LCD Modules supplied by AVC LCD Group. Sharp Corporation to LG Electronics INC

### 2. Inspection Lot

- Quantity per shipment lot is ONE Inspection lot.

### 3. Incoming Inspection Condition

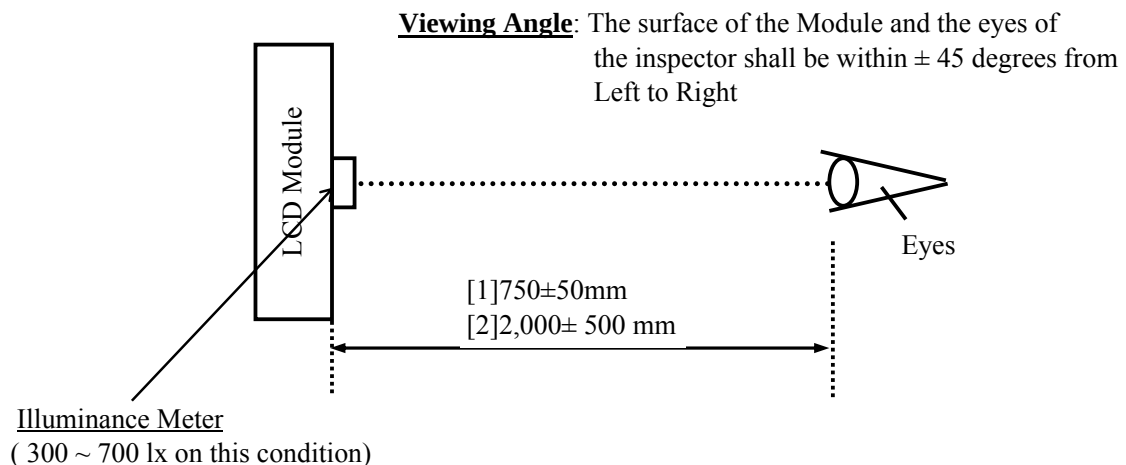
#### **3.1 Condition of Lot Judgement**

- Unless otherwise agreed in writing, the method of incoming inspection shall be in accordance with a sampling inspection based on ISO 2859-1
  - Sampling Table : Table in ISO 2859-1
  - Sampling Type : Single Sampling Plan
  - Inspection Level : Level II, Normal Inspection
  - Acceptable quality level (AQL) : Major defects: AQL: 0.4  
: Minor defects: AQL: 1.0
- Defects are classified as major defect and minor defect according to Classification on Defects Minor & Majors of item# 6.
  - a) Major defect: Major defect is a defect that is likely to result in failure, or to reduce materially the usability of the product for its intended purpose.
  - b) Minor defect: Minor defect is a defect that is assumed to be little or no obstacle to usability of inspection unit, effective usage or operation of the product.

#### **3.2 Operational Inspection Condition**

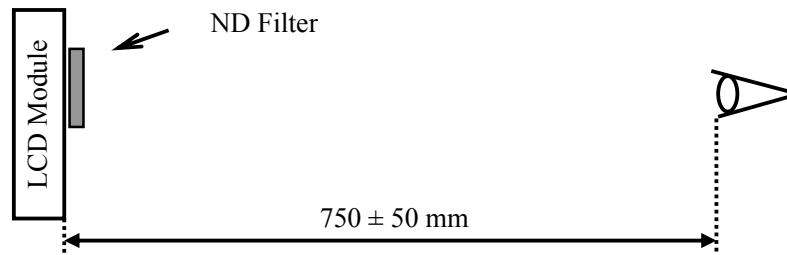
- The inspection shall be conducted in the standard operative condition described in the specification.
- The external illumination on the Module: 300 ~ 700lx (Standard 500lx)
- The viewing distance between center of panel surface on the Module and the eyes of the inspector.
  - \*Refer to Fig.1 and Fig.2 [Inspection :Viewing Angle from Left to Right  $\pm 45$  degrees]
- [1] Apply to Foreign material, Bright Dot and Black Dot.
- [2] Apply to defect concerned with Mura (Display Uniformity)
- Backlight Luminance: Based on value which is described in the specification.(Brightness Control : 100%)
- Ambient temperature:  $24^{\circ}\text{C} \pm 2^{\circ}\text{C}$  in principle
- Ambient humidity:  $65 \pm 5\%$  RH in principle

**Fig.1) Judgment position of Operational Inspection Inspector**

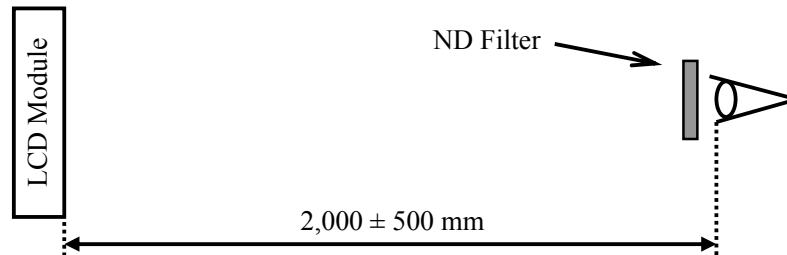


**Fig.2) How to use ND Filter**

- [1] Apply to Bright Dot and Tiny Bright Dot (Small dots seem to be bright by foreign material)  
ND filter is moved to the panel side closer and judged.



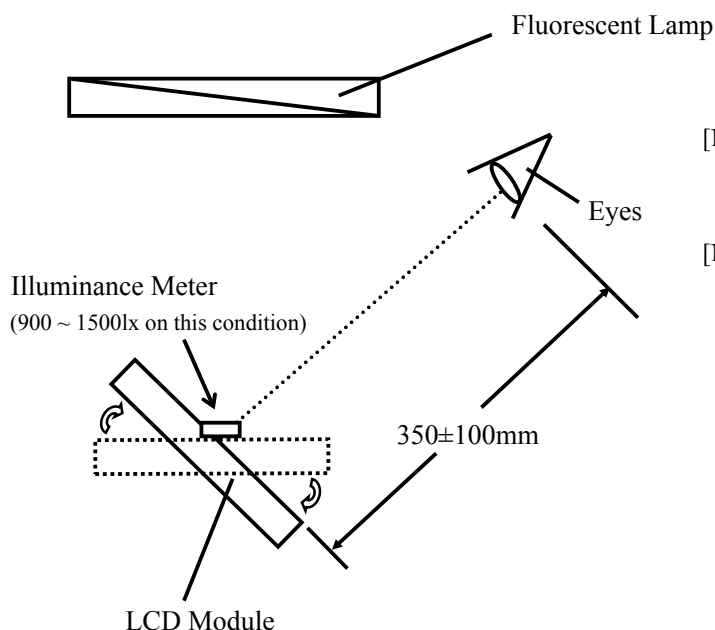
- [2] Apply to defect concerned with Mura (Display Uniformity)  
ND filter is moved to the eyes closer and judged.



### 3.3 Appearance Inspection Condition

- \*1: In the operational inspection condition, the distance between the Module and eyes of the inspector shall be 750mm or MORE. (Condition of lighting B/L and operating Module on White picture)
- \*2: In the operational inspection condition, the distance between the Module and eyes of the inspector shall be 750mm or MORE. (Condition of lighting B/L and operating Module on Black picture)
- \*3: The external illuminance of panel surface; 900-1500lx (Standard: 1200lx)  
Shall be conducted with fluorescent lamp lighting on working bench. [Refer to Fig.3]  
The visual observation shall be conducted with the judgement distance that is  $350 \pm 100$ mm between the panel and the inspector's eyes. (Condition of Non-operating)

**Fig.3) Judgement position of Appearance Inspection Inspector**



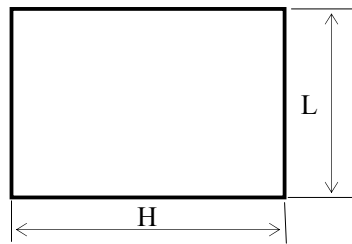
[Note] Applicable range of Appearance inspection is out side by 3.0 mm from the effective display area.

[Note] Scratch/Dent on the rear polarizer is not counted, if it is not found from the front side by B/L lighting condition.



## 4. Standards for Display Quality Inspection

### 4.1 Zone



• H and L are assumed all the effective display area.

### 4.2 Definition

#### a) Bright dot

Full-time lighting dot in the black display.

- Visible through 5% ND filter : Counted as Bright dot
- Not visible through 5% ND filter : Non count

#### b) Tiny bright dot

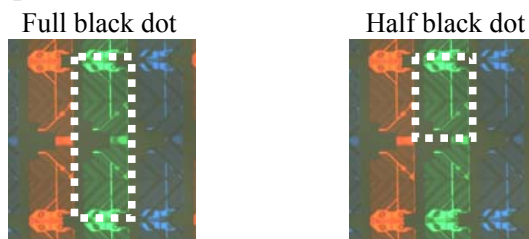
Small dots seem to be bright by foreign material

- Visible through 5% ND filter : Tiny bright dots(Counted as Bright dot)
- Not visible through 5% ND filter : Bright foreign material

#### c) Black dot

Dot which seems to come out in black on the white display and Red/Green/Blue monochromatic display. There are full-dot black dot and half-dot one due to the multi-pixel structure.

#### Fig.4) Example: Full black dot & Half black dot

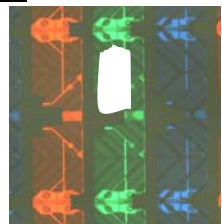


#### d) Scratches on color filter

\*White dot on the Black display.

- Visible through 5% ND filter : Tiny bright dots(Counted as Bright dot)
- Not visible through 5% ND filter : Bright foreign material

#### Fig.5) Example: Scratch on the color filter



#### e) Scratches on black mask

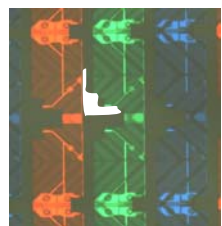
\*White dot around R/G/B dot (black mask part) on the black display.

- Visible through 5% ND filter : Tiny bright dots(Counted as Bright dot)
- Not visible through 5% ND filter : Bright foreign material

[Target Area]

Target area is from active area to 1.5mm (High density is NG)

#### Fig.6) Example: Scratch on the black mask



#### f) Line defect (Vertical / Horizontal / Cross)

\*All kinds of line defects such as Vertical, Horizontal or Cross are not allowed.

#### g) Display Mura (Non-Uniformity)

\* Non-Uniformity of display brightness.

## 4.3 Bright dot

| Check pattern                         | Acceptable total number of Bright dot |
|---------------------------------------|---------------------------------------|
| Black pattern<br>(Refer to Item# 4.2) | 0                                     |

## 4.4 Black dot

| Check pattern                                                          | Acceptable total number of Black dot |                   |                      |                         |
|------------------------------------------------------------------------|--------------------------------------|-------------------|----------------------|-------------------------|
|                                                                        | Half Black dot(A)                    | Full Black dot(B) | Joined Black dots(C) | Total=1/2×(A)+(B)+2×(C) |
| White pattern and at each pattern of R, G and B<br>(Refer to Item#4.2) | 16                                   | 8                 | 4                    | 8                       |

[ Note ] Flashing dot is counted as a Black dot

[ Note ] Joined Black dots shall be based on “Explanation for Black Dot criterion and Judgement method.”

[ Note ] Joined more than 1.5 Black dots by Vertical shall be judged NG.

## 4.5 Distance of Black Dot

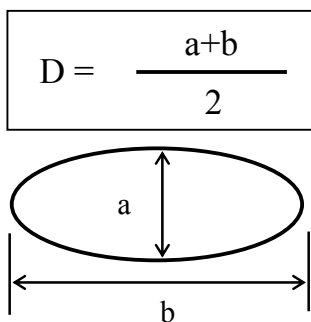
- Full Black dot,Joined Black dots - Full Black dot,Joined Black dots : Acceptable if it is more than 15mm
- Half Black dot - Half Black dot : Acceptable if it is Max 3 dots within 5mm φ
- Full Black dot,Joined Black dots - Half Black dot : Acceptable if it is more than 15mm

## 5. Appearance Inspection Criterion

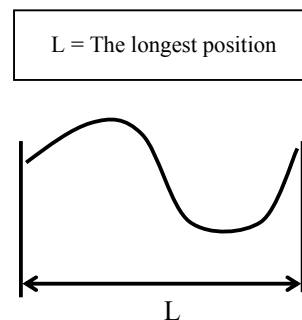
[ Permissible Nnumber: N, Average Diameter(Fig.7): D (mm), Length(Fig.8): L (mm) ]

| Item                                                         |          | Judgment Criterion                                                       | Appearance Inspection Condition                          |
|--------------------------------------------------------------|----------|--------------------------------------------------------------------------|----------------------------------------------------------|
| Foreign material<br>(in the polarizer /<br>backlight / cell) | Circular | $0.3 \leq D \leq 0.8$ , $N \leq 10$                                      | Condition of operation<br>(Refer to *1 of Item#3.3)      |
|                                                              | Linear   | $L \leq 3.0$ , $N \leq 3$                                                | Condition of operation<br>(Refer to *1 & *2 of Item#3.3) |
| Bright Foreign material<br>(in the polarizer / cell)         |          | $0.1 \leq D \leq 0.5$ , $N \leq 10$<br>Not visible through 5% ND filter. | Condition of operation<br>(Refer to *2 of Item#3.3)      |
| Scratches on the polarizer/glass                             |          | $L \leq 10.0$ , $N \leq 4$                                               | Condition of Non operation<br>(Refer to *3 of Item#3.3)  |
| Dents on the polarizer/glass                                 |          | $0.3 \leq D \leq 0.8$ , $N \leq 10$<br>$0.3 > D$ : No count              |                                                          |

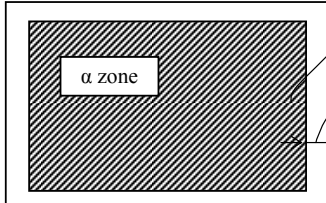
**Fig.7) Average diameter : D**

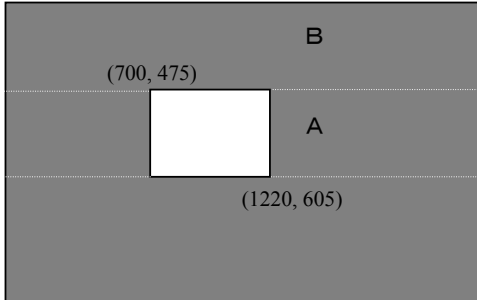


**Fig.8) Length : L**



## 6. Classification on Defects Minor & Majors

| Classification                               | Inspection item                                                                  | Criterion for defects / Judgment                                                                                                                                                                                                                                                                                                                       | Defect type        |       |
|----------------------------------------------|----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|-------|
| Characteristic of electricity and mechanical | A power supply voltage shall be a standard value described in the specification. |                                                                                                                                                                                                                                                                                                                                                        |                    |       |
|                                              | Operating frequency                                                              | (1) Does not meet the specified range in the specification                                                                                                                                                                                                                                                                                             | Major              |       |
|                                              | Current consumption                                                              | (2) Does not meet the specified range in the specification                                                                                                                                                                                                                                                                                             | Major              |       |
|                                              | Contrast ratio                                                                   | (3) Does not meet the specified range in the specification                                                                                                                                                                                                                                                                                             | Major              |       |
|                                              | Display Inspection                                                               | (4) Correct pattern is not displayed when the display pattern is input.                                                                                                                                                                                                                                                                                | Major              |       |
|                                              |                                                                                  | (5) Vertical line defect                                                                                                                                                                                                                                                                                                                               | Major              |       |
|                                              |                                                                                  | (6) Horizontal line defect                                                                                                                                                                                                                                                                                                                             | Major              |       |
|                                              |                                                                                  | (7) Cross line defect                                                                                                                                                                                                                                                                                                                                  | Major              |       |
| Criterion for External Quality               | Scratches and dent on the polarizer                                              | (8) Shall be accordance with the Item#<br><b>"5.Appearance Inspection Criterion"</b>                                                                                                                                                                                                                                                                   |                    | Minor |
|                                              | Bubble in the polarizer                                                          | (9) Shall be accordance with the Item#<br><b>"5.Appearance Inspection Criterion"</b>                                                                                                                                                                                                                                                                   |                    | Minor |
|                                              | Foreign material                                                                 | (10) Shall be accordance with the Item#<br><b>"5.Appearance Inspection Criterion"</b>                                                                                                                                                                                                                                                                  |                    | Minor |
|                                              | Appearance of Bezel                                                              | (11) Irregular plating / Irregular Coating / Rust on the edge are ignored                                                                                                                                                                                                                                                                              |                    | Minor |
|                                              | Damaged Material                                                                 | (12) a)The lead wire is broken.<br>b)Although the lead wire is not broken (not disconnected) and does not affect the operation and reliability of LCD module it has scratch.<br>c)Failure is found concerning function or performance, or product value is impaired in appearance.                                                                     | Major<br><br>Major | Minor |
| Criterion for Display Quality                | Bright dot                                                                       | (13) Exceed permissible value                                                                                                                                                                                                                                                                                                                          |                    | Minor |
|                                              | Scratch on the color filter                                                      | (14) Exceed permissible value                                                                                                                                                                                                                                                                                                                          |                    | Minor |
|                                              | Scratch on the black mask                                                        | (15) Exceed permissible value                                                                                                                                                                                                                                                                                                                          |                    | Minor |
|                                              | Black dot                                                                        | (16) Exceed permissible value (Flashing dot is classified as a black dot)                                                                                                                                                                                                                                                                              |                    | Minor |
|                                              | Display Mura (Non-uniformity)                                                    | (17) There should not be Non-uniformity through 5%ND filter.                                                                                                                                                                                                                                                                                           |                    | Minor |
|                                              | Remained electric charge                                                         | (18) Electric charge is remained for more than 3seconds in the α-zone immediately after power-off.<br><br>(Illuminance condition around : 300~700lx(standard 500lx))<br><br><br>Within 3 seconds [Inspection condition]<br>-Signal power is off<br>-B/L power is on |                    | Minor |

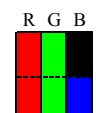
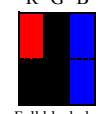
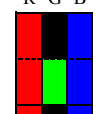
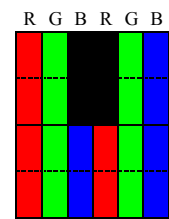
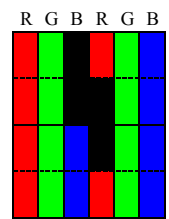
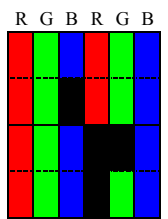
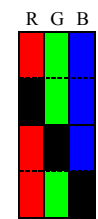
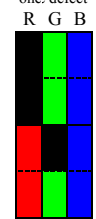
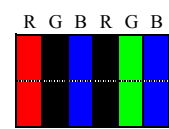
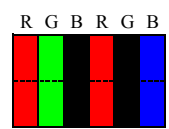
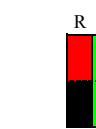
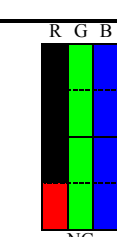
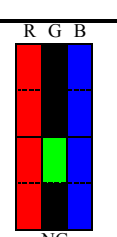
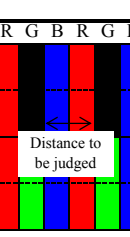
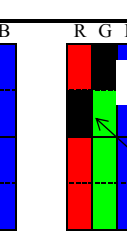
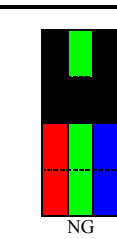
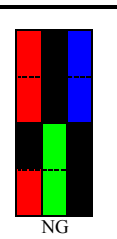
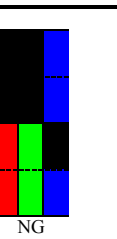
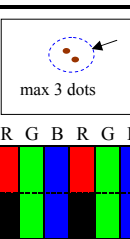
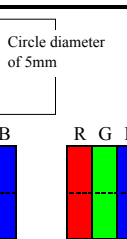
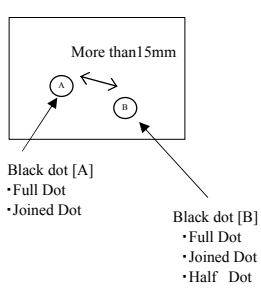
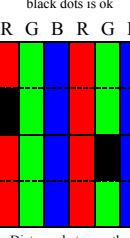
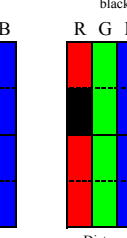
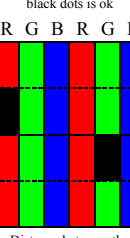
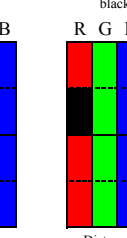
| Classification                | Inspection item                      | Criterion for defects /determinations                                                                                                                                                                                                                                       | Defect type |       |
|-------------------------------|--------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|-------|
| Criterion for Display Quality | PI Repellent                         | (19) One dot-shaped black stain is considered as “good product”.(But, if it seems to be bright dot when changing viewing angle, it’ll be counted as small bright dot)                                                                                                       |             | Minor |
|                               | Long time afterimage                 | (20) Afterimage of the former pattern is not disappeared within 10 seconds when a pattern was displayed for 30 minutes and switch to another pattern.                                                                                                                       |             | Minor |
|                               | Short time afterimage                | (21) After display same pattern for 5 seconds, the afterimage is not disappeared within 10 seconds.                                                                                                                                                                         |             | Minor |
|                               | Shadowing                            | (22) The brightness difference between A section and B section is visible through 10%ND filter.<br><br><br>Ambient: V64<br>Window : V255                                                  |             | Minor |
| Others                        | Outline dimensions                   | (23) Does not meet specified range in the specification                                                                                                                                                                                                                     | Major       |       |
|                               | Weight                               | (24) Does not meet specified range in the specification                                                                                                                                                                                                                     | Major       |       |
|                               | Rating label (Sealing/Display label) | (25) A) The one that is forgetting, misprinting or not-readable.<br>(Readable one should be a good one.)<br><br>B) As for the display label, peel-off is more than the degree of 1/10 of total area .<br><br>(except for legible one among discoloration of display label.) | Major       | Minor |

[Note] Regarding the items to use limit samples, limit samples should have priority over others

## 7.Others

In case any doubts arise on the items, both Parties shall cooperate in an effort to settle it down.

## Explanation for Black Dot criterion and Judgment method

| Judgment Method                                                                                                                                                                              | Example                                                                             |                                                                                     |                                                                                     | Judgment Method                                                                                                              | Example                                                                               |                                                                                       |                                                                                     |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| A half dot not lit on each color screen of R, G or B is judged Half Black dot with one defect.                                                                                               |    |    |    | Dots seemed continuous with Horizontal and Slant on each color screen of R, G or B is judged Full Black dot with one defect. |    |    |  |
| A one dot not lit on each color screen of R, G or B is judged Full Black dot with one defect.                                                                                                |    |    |    |                                                                                                                              |    |    |  |
| Dots seemed continuous with Horizontal and Slant on each color screen of R, G or B is judged Joined Black dots with one defect.                                                              |    |    |   |                                                                                                                              |    |    |  |
| A black dot within a pixel on each color screen of R, G or B (black mode opened one dot) is counted one defect. Distance between the black dots is not judged. 1 pixel = 1 dot each of R+G+B |    |    |                                                                                     |                                                                                                                              |    |    |                                                                                     |
| Dots seemed joined with Vertical on each color screen of R, G or B are NG.                                                                                                                   |  |  |  | Distance between the black dots exceeding one pixel on the white screen is rejected.                                         |  |  |                                                                                     |
| Joined 3 dots on each color screen is judged of R, G or B are NG.                                                                                                                            |  |  |  |                                                                                                                              |  |  |                                                                                     |
| Distance between black dot "A" to black dot "B" is 15mm or more in a white picture                                                                                                           |  |                                                                                     |                                                                                     |                                                                                                                              |  |  |                                                                                     |
|                                                                                                                                                                                              |                                                                                     |                                                                                     |                                                                                     |                                                                                                                              |  |  |                                                                                     |